1939, No. 4 DECEMBER 26

COPEIA

Established in 1913

PUBLISHED BY
THE AMERICAN SOCIETY OF ICHTHYOLOGISTS
AND HERPETOLOGISTS

Copeia *1939, No. 4* *December 26*

CONTENTS

Published quarterly by the American Society of Ichthyologists and Herpetologists, at the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, under the Act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized February 11, 1924.

Spawning Habits and Development of Beau-gregory (*Pomacentrus leucostictus*)

By Floyd J. Brinley[1]

WHILE studying the action of various drugs on muscular movement in fish embryos at the Carnegie Laboratory at Dry Tortugas, it was found that the eggs of *Pomacentrus leucostictus* were extremely abundant. They are deposited in separate clusters of several hundred in old conch shells and can be easily collected in various stages of development during June, July and August. As the embryos proved to be very favorable material for the above studies, it was deemed advisable to call the attention of other investigators, who may be interested in a similar problem, to this material.

The range of *Pomacentrus leucostictus* as given by Breder (1929), is the West Indies, north to Florida and rarely to Katama Bay, Maine. This is one of the most abundant coral reef fishes at Dry Tortugas, especially along Bird and Long Key reefs. During the summer months numerous individuals ranging from a half inch long to adult size can be seen to dart into old conch shells or under coral rocks and sea fans as one works along the reef at low tide. They are easily obtained by collecting the conch shells in which they have taken refuge and may be kept in a running water aquarium. They are usually found in comparatively shallow water but frequent water of 2 or 3 fathoms in depth.

The eggs are deposited in closely packed clusters of several hundred commonly in old conch shells which are uninhabited by crabs, brittle-stars, etc., and which are not disintegrating or encrusted with coral or algae. In some localities nearly all the conch shells contain one to four batches of *Pomacentrus* eggs in various stages of development. In places where these shells are not plentiful the adults will deposit eggs on the under surface of coral rocks, dead sea fans, Pinna shells, tin cans, bottles; and on one occasion several batches were found attached to the under side of an old shovel. The eggs are carefully guarded, exclusively by the male. As one approaches the nest the male will dart into the shell, and if care is exercised he can be collected with the eggs. The shell with the adult and eggs can then be transferred to a running water aquarium where the embryos will develop. There is seldom more than one adult in a shell with eggs but when more than one occurs, only one is a male and the others are females. The number of batches of eggs in the same conch shell varies from one to four. Each batch is in a different stage of development. This indicates that they were deposited at various times either by the same or by different females. In several instances females with gonads completely spent have been collected from shells in which there was only one batch of newly laid eggs. This indicates that all the eggs in the ovaries are deposited at the same time. One conch shell was collected which contained two batches of eggs with one male and three females. The ovaries of the females were filled with well developed eggs, about ready to be

[1] This work was done while the author was a guest of the Carnegie Institution of Washington at their Marine Laboratory at Dry Tortugas, and he wishes to express his thanks and appreciation to the Institution for an opportunity to study at that Laboratory.

laid. These observations seem to indicate that each batch of eggs is laid by a different female and she leaves the nest or is driven from it by the male soon after depositing them, when her place is taken by a gravid female ready to lay another batch of eggs. The males are pugnacious and will not allow intruders to come near the nest, not even a female that is not ready to lay.

The newly laid eggs are oblong in shape, resembling minute gelatin capsules, 0.4 mm. in diameter and 0.8 mm. in length. They are attached at one end to the object upon which they are deposited by a tuft of filaments. The yolk is perfectly clear and transparent, and the blastodisc forms a cap over about one-third of the basal end of the yolk sac. A distinct perivitalline space exists between the yolk and chorion at the distal end (fig. 1). In about six hours the protoplasmic cap has migrated to one side of the yolk sac where it forms a slightly elevated ridge along the long axis of the egg (fig. 2). Within another ten hours the developing embryo can be seen along the long axis of the egg with the head towards the basal end. The optic lobes with the lenses are faintly visible. A few scattered melanophores have appeared on the dorsal region of the head, two or three on the body of the embryo and two on the yolk sac. Thirteen somites are distinctly visible. The tubular heart can be seen in the pericardial cavity but no contractions occur (fig. 3). Seven hours later the heart starts to beat but no blood is circulating; more melanophores appear on the head and body. The developing brain has formed its three major divisions, fore-, mid- and hind-brain. The otic vesicle is visible in the region of the metacephalon. The tail has separated from the yolk and shows slight muscular twitching. The yolk sac is becoming smaller and the oil droplets are coalescing to form larger globules (fig. 4). Seven hours later the embryo has rotated in the chorion so that the head is situated in the distal end of the egg. Numerous chromatophores have appeared over the body of the embryo and yolk sac. Spontaneous twitching of the tail is decidedly evident. The urinary bladder (?) appears caudad to the rectum (fig. 5). Twelve hours later the blood is circulating through the embryo and over the yolk sac. Orange color pigment cells have appeared around the eyes and caudal to the otic vesicle (fig. 6). In twenty-four hours the eyes become pigmented, the heart has shifted ventrally and a large blood vessel, visible over the yolk sac, carries blood to the heart. The pectoral fin buds have appeared (fig. 7). The next day, the eyes are densely pigmented, and numerous black and yellow chromatophores have appeared along the sides of the tail and dorsal fin. The pectoral fins are well developed and show muscular movement. The large urinary bladder is plainly visible at the base of the tail, posterior to the cloaca. The mouth has formed and the jaws and operculum are movable (fig. 8). The eggs hatch on the fifth day after they are laid, at room temperature varying from 28–31° C. Hatching is accomplished by the embryo's forcing its way out of a slit made in the distal end of the chorion, which has previously been softened, probably by some secretion from the embryo. The newly hatched larva is about 3 mm. long with a large head and protruding mandible (fig. 9). A few melanophores are present on the dorsal surface of head and the dorsal wall of the body cavity is heavily pigmented. The lateral line is marked from the yolk sac to the base of the tail by a single row of melanophores. The anterior portion of the prominent

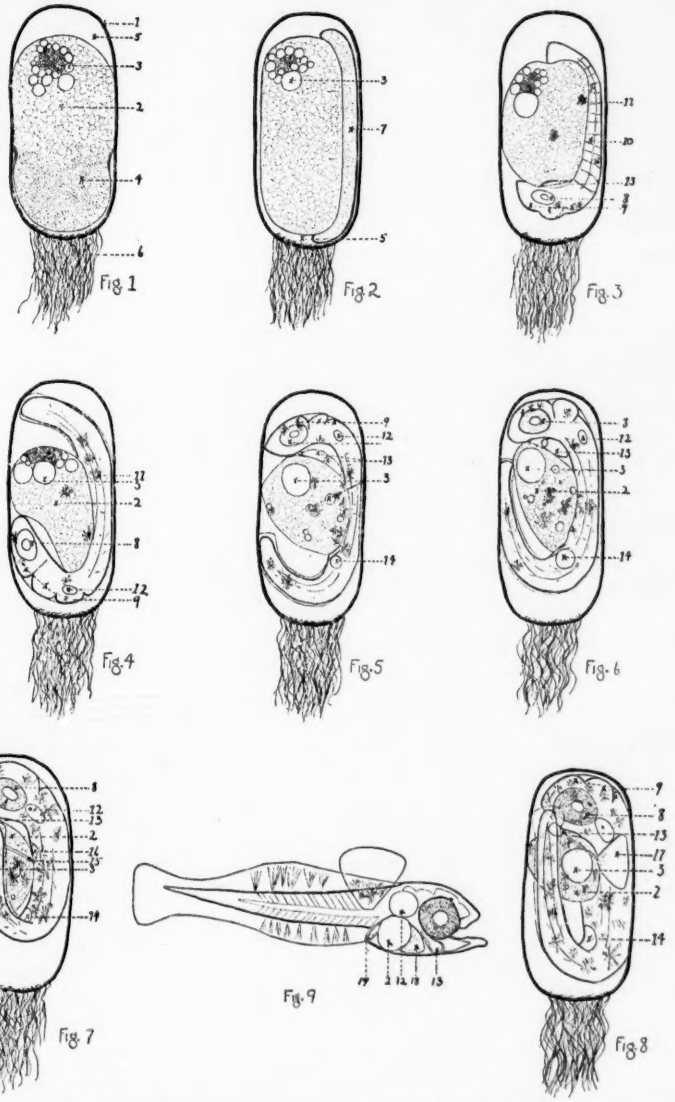

Fig. 1. Recently fertilized egg of *Pomacentrus*, collected July 16, 1938, at 4:00 P.M. Fig. 2. Same egg at 10:00 P.M. Fig. 3. Same egg July 17, 8:00 A.M. Fig. 4. On July 17, 3:00 P.M. Fig. 5. On July 17, 10:00 P.M. Fig. 6. On July 18, 8:00 A.M. Fig. 7. On July 19, 8:00 A.M. Fig. 8. On July 20, 8:00 A.M. Fig. 9. Day old larva.

1, clorion; 2, yolk sac; 3, oil droplets; 4, germ disc; 5, perivitalline space; 6, filaments; 7, blastula; 8, eye; 9, fore-, mid-, and hind-brain; 10, somites; 11, chromatophores; 12, otic vesicle; 13, heart; 14, urinary bladder; 15, postcardinal vein; 16, pectoral fin bud; 17, pectoral; 18, liver; 19, rectum.

dorsal fin is colored with yellow thread-like chromatophores, preceding a band of melanophores. The anal fin has a band of delicate melanophores a short distance posterior to the anus. The pectoral fins are large and pigmented with brownish chromatophores. A few scattered melanophores are found along the dorsal body wall. Peristalsis occurs in embryos a day or two before hatching and can be easily seen in newly hatched larvae. It is first observed in the fore- and hind-gut and later develops in the mid-gut. Contractions occur in the fore-gut at a definite rhythm of about 24 contractions per minute. Peristalsis originates in the anterior region of the fore-gut and passes posteriorly where it ceases before entering the mid-gut. Contractions of the hind-gut occur at irregular intervals and may originate at the junction with the mid-gut or at the posterior end. Contractions of the mid-gut are less frequent and occur at irregular intervals. These three regions of the alimentary canal behave as separated physiological units, being independent of each other's muscular activity. The urinary bladder, which has gradually been increasing in size up to this stage, disappears. The liver and gall bladder are plainly visible. Practically all the yolk is absorbed but the sac is filled with oil globules. Peristalsis of the intestines forces undigested material from the yolk sac out of the anal opening.

Literature Cited

Brinley, F. J.
1938 Study of the origin of muscular movement in fish embryos. *Ann. rept. of the Tortugas Lab. Carnegie Yearbook*: 86-87.

Breder, C. M.
1929 Field book of the marine fishes of the Atlantic coast. *Putnam's Sons, New York.*

North Dakota State College, Fargo, North Dakota.

A Description of Four Specimens of the Sole, *Nodogymnus williamsoni*, with Notes on the Species

By Gordon Gunter

THE sole, *Nodogymnus williamsoni*, was described from one specimen (Gunter, 1936) and, although the fish differed clearly from other descriptions, individual variations and certain constant species characteristics could not be sharply differentiated. For that reason I was glad to get the opportunity, through the kindness of Dr. Carl L. Hubbs, of examining four specimens from Boca Ciega Bay, west Florida, which is about 200 miles southeast of the type locality. The fish were collected by Mr. William G. Fargo and were sent to me as a loan from the Museum of Zoology, the University of Michigan. A study of four additional specimens has added considerably to our knowledge of the species.

Common Characteristics

The eyes are small, very close together, have a common membrane and are vertically aligned. Figure 1-C shows the position of the eyes in specimen 3. The small papillae surrounding the base of the eye membrane can be seen

clearly. In this fish alone the anterior margin of the dorsal (migratory) eye appeared to be almost unnoticeably posterior to the anterior margin of the ventral eye. Chabanaud (1937) has pointed out that among the Soleidae, Achiridae and Cynoglossidae, only in the genera *Gymnachirus* and *Nodogymnus* are there exceptions to the rule that the migratory eye is anterior to the ventral eye. The eyes of specimen 3 were selected for photography because they were more protuberant than those of other fish. This fact may have made the true eye position more apparent than in the others where it is called vertically aligned.

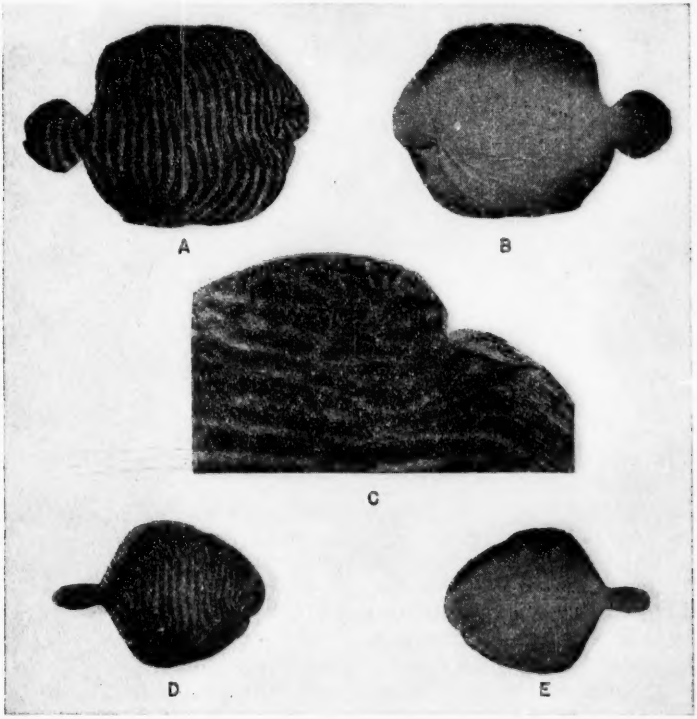

Fig. 1. A, eyed side, B, blind side, of specimen 1. C, head region of specimen 3. D, eyed side, E, blind side of specimen 4.

The inhalant nostril is on a level with the dorsal margin of the ventral eye, and one-third of the distance from the mouth to the end of the snout. The exhalant pore is in the labial groove, ventral and slightly posterior to the inhalant nostril. There are no nostrils on the blind face.

The front margin of the fish and the edges of the labial grooves are fringed with fleshy cirri. On the blind side there is a reticulum of colorless cirri on the head region.

The pectoral fin or its rudiment is just posterior to the end of the gill cleft, on a level with the ventral margin of the ventral eye. The urinary papilla is above the first anal ray, even with the anus on the opposite side, but a little above it.

The color pattern of the stripes is not precisely constant, but in general the first seven stripes back of the head curve posteriorly at the ends, whereas the last four run straight. The intervening lines are both curved and straight and do not run entirely across the body. On the blind side the margin of the fins, especially posteriorly, and the caudal penduncle are dark or black. The bifurcated fin tips are always colorless.

TABLE I

DIAGNOSTIC CHARACTERS OF FOUR SPECIMENS OF *Nodogymnus williamsoni* FROM BOCA CIEGA BAY, FLORIDA; MEASUREMENTS IN MILLIMETERS

SPECIMEN	1	2	3	4
CATALOG NUMBER	119702	119702	119702	119701
DATE COLLECTED	April 5, 1938	April 4, 1938	April 6, 1938	January 31, 1938
TOTAL LENGTH	126	108	106	77
STANDARD LENGTH	94	80	82	58
DEPTH (without fins)	60	48	49	34
HEAD	23	21	21	15
EYE	5	4.3	4.7	3
DEPTH IN STANDARD LENGTH	1.57	1.66	1.67	1.71
HEAD IN STANDARD LENGTH	4.03	3.80	3.90	3.87
EYE IN HEAD	4.6	4.8	4.5	5.0
DORSAL	56	57	57	58
ANAL	49	49	46	47
RIGHT PECTORAL	a papilla	a flap with long ray	a stubby papilla	1
PELVICS (bound together)	5–5	5–5	5–5	5–5
CAUDAL	16	16	16	16
NUMBER OF ACCESSORY SENSORY LINES BACK OF THE HEAD, EYED SIDE	9	9	10	8 (2 double)

COLOR PATTERNS

Specimen 1. Eyed face.—Fourteen dull black stripes on the body extend across and two do not extend all the way across. There are six stripes on the head, four stripes on the tail (one double) and a dark margin. The background is a slate grey (fig. 1-A). Blind face.—Figure 1-B shows the small color splotches which parallel the lateral line for over half the body length.

Specimen 2. Eyed face.—Thirteen dull black stripes run all the way across the body back of the head and two do not extend all the way across. There are five stripes on the head, two not extending all the way across, and three stripes on the tail. The background is a dull slate grey. Blind side.—The pattern of splotches along the sides of the lateral line extend to the shoulder region. The background is cream white. One accessory sensory line was seen on this side.

Specimen 3. Eyed face.—The coloration of this animal was not natural, being bleached in spots, due perhaps to some action of the preservative. There can be seen thirteen stripes running all the way across the body back of the head and four running part way across. There are six stripes on the head, two not running all the way across, and five on the tail. There are no splotches on the blind face, owing presumably to the bleaching.

Specimen 4. Thirteen shiny black stripes are on the body back of the head.

There are five stripes on the head and three on the tail which, due to the black background, are almost indiscernible. The body edges and fins are darker than other areas. The tips of the bifurcated fin rays are colorless even in this melanistic specimen. Figs. 1-D and E show the color pattern on both sides. The background of the blind side, instead of being cream or dull white, was slightly grey, with a brownish tint, owing to the transparency of the skin showing the flesh underneath. Figure 2 shows the lateral line pattern on the right side. This specimen was very slick and smooth like the type specimen. The other three fish did not have the same smooth texture.

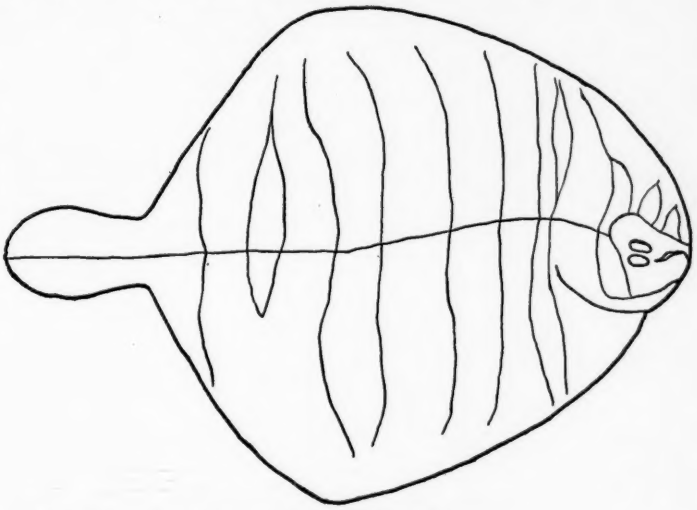

Fig. 2. Sensory line pattern on the right side of specimen 4.

Discussion

The skin of all specimens was very loose, as noted for the type (fig. 1-B), the smallest fish being least so. I have seen no description of this characteristic for other species, and probably it is a specific peculiarity.

Body measurements, including the holotype, show no change in proportions from the smallest to the largest fish, except an indication that the body becomes larger with respect to the head with increase in size.

The ray counts of the dorsal fin are much lower than the 70 given for the type, but I am convinced that the latter figure was too high owing to a confusion of fin rays and cirri on the head region.

The small blotches on the blind side extending from the tail forward on each side of the lateral line, were noted in the three good specimens, as for the type, and presumably are a species characteristic. The blind side of the type specimen was described as white. That of the three larger specimens described here was cream white, while that of the smallest specimen was a light grey. The small specimen was much darker than any of the others.

There is another indication that juvenile soles are darker than their parents. *Nodogymnus melas* (Nichols, 1916) was so named because of the dark coloration of its type, but a much larger, lighter colored specimen has been identified in the U. S. National Museum by Dr. George S. Myers. (footnote, Gunter, 1936).

In the type specimen fainter, narrower color lines were spaced between the dark bands. These were barely distinguishable in all the other fish except the smallest, and were best seen in the largest. Probably the faint color bands become stronger as the fish approaches adult size.

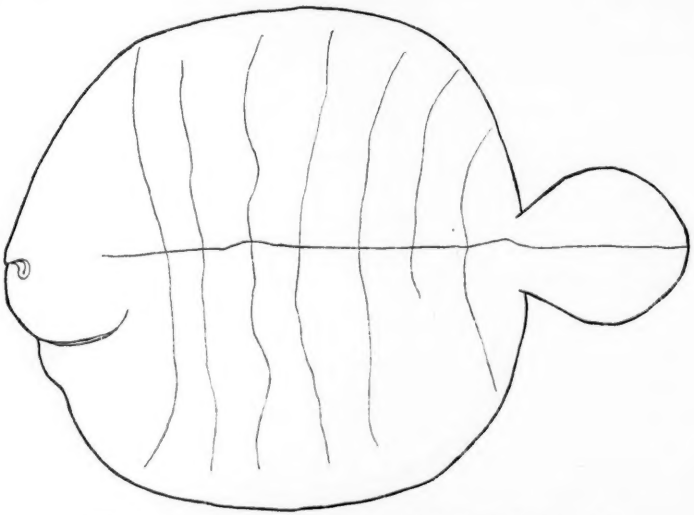

Fig. 3. Sensory line pattern on the blind side of Specimen 1.

Attention has been called to the accessory sensory lines on the body and the concentric lines on the head (Gunter, *op. cit.*).[1] Further study has shown that the accessory lines are discernible on the blind side of at least some specimens (fig. 3). The main lateral line shows up as a cordon on which the pores are studded more thickly than on the accessory lines. There is no cordon on the accessory lines, which are detected by the pores irregularly but linearly spaced. In addition, a colorless streak indicates the line in some places on specimen 4. The pores are mere colorless holes in the skin. Over some of them are two, in some cases three, black papillae tapering to a colorless tip, and in juxtaposition so that they have a hemitubular appearance. Even on the blind side a few chromatophores are present on these papillae. Kendall (1911), in describing a naked sole which he identified as *Gymnachirus fasciatus*, stated that there were vertical rows of cirri with colorless tips on the eyed side. On the head the pores are scattered. Evidently a network of afferent nerve fibers runs to them. Scattered over the skin are

[1] Miranda Ribeiro (1916) has described such lines on the head of *Nodogymnus zebrinus*.

a few long black papillae having no apparent connection with the sensory lines. There are no remnants of scales.

According to the descriptions, *Nodogymnus williamsoni* differs from all scaleless soles except *N. texae* [2] by possession of the accessory sensory lines, and colorless, not white, fin tips. It differs from *N. nicholsi* (Nichols and Heilner, 1928; Norman, 1931), which has the dorsal eye posterior to the ventral eye, in having the eyes aligned, and in having no black border on the fin edges. *N. zebrinus* (Chabanaud, 1928) has widely separated eyes, no common eye membrane, and the eyes are not aligned. The species also differs from *N. zebrinus* and *N. fasciatus* in having no nasal openings on the blind side. It differs from all naked soles in having a loose, wrinkled skin and a line of dark splotches on each side of the lateral line on the blind side. Lastly it differs from all species heretofore described, in having a color pattern of white, grey and black, not brown, fawn brown, reddish brown or olivaceous.

I am indebted to Mr. Joel Hedgpeth of the Department of Zoology, University of California, for the photographs.

Literature Cited

Chabanaud, Paul
1928 Revision des Poissons Hétérosomes de la sous-famille des Achirinae, d'apres les types de Kaup, de Günther et de Steindachner. *Bull. Inst. Oceanogr. Monaco.*, 523: 1–53.

Chabanaud, Paul
1937 Les Teléostéens Dyssymétriques du Mokattam Inférieur de Tourah. *Mémoires l'Institut d'Egypte*, 32: xi, 1–121.

Gunter, Gordon
1936 Two new species of naked soles from the Gulf of Mexico, with notes on a third species. Copeia, (4): 203–209.

Kendall, W. C.
1911 Notes upon two rare flatfishes (*Gymnachirus fasciatus* Günther and *G. nudus* Kaup). *Proc. U. S. Nat. Mus.*, 40: 201–203.

Miranda Ribeiro, A. de
1916 Fauna Brasiliense-Peixes. *Archivos do Museu Nacional do Rio de Janeiro*, 17: 659.

Nichols, J. T.
1916 A new *Gymnachirus* from North Carolina. *Bull. Amer. Mus. Nat. Hist.*, 35: 71–72.

Nichols, J. T., and Van Campen Heilner
1928 A rare sole from the Bahamas. *Amer. Mus. Novit.*, 326: 1.

Norman, J. R.
1931 A new sole from the Bahamas. *Ibid.*, 477: 1.

Coastal Division Game, Fish and Oyster Commission, Rockport, Texas.

[2] This latinization of Texas, which unfortunately cannot be changed, is open to criticism on grammatical grounds.

The Food of Pickerel

By George W. Hunter, III, and John S. Rankin, Jr.

Introduction

SIX species of pickerel are found in the majority of lakes and tributaries throughout North America. These are, according to the classification of Weed (1927): *Esox americanus* Gmelin, the grass pickerel; *E. niger* Le Sueur, the chain pickerel; *E. lucius* Linnaeus, the common pickerel; *E. ohioensis* Kirtland, Chautauqua muskalonge; *E. masquinongy* Mitchill, St. Lawrence muskalonge; and *E. immaculatus* Garrard, the Wisconsin muskalonge. The muskalonge will not be considered further in this paper. Although the term "pickerel" is a general one and includes the three species, *Esox americanus*, *E. niger*, and *E. lucius*, attention will be directed to the former two species.

The pickerel is ranked as an excellent game fish by sportsmen; it affords good fishing for a large number of people throughout its range, and in actual monetary value is of appreciable economic importance. In spite of the fact that pickerel are commonly well known, few complete records of their food have been reported. It was felt desirable, therefore, to collect more data from a restricted locality on two species, *Esox americanus* and *E. niger*. Only occasional specimens of *E. lucius* were examined. The collection of data was begun in the fall of 1932, continued through the spring of 1933, and, occasionally, during the summers of 1934, 1935, and 1936.

Much has been written concerning the food of pickerel, but a large part has appeared in popular articles or in brief accounts included in longer papers of a more general character.

The voracity and omnivorous habit of this group of fishes is well brought out in a study of the literature. A variety of food, including frogs, leeches, trout, young water-fowl, and weeds is recorded by Seeley (1886) from *E. lucius*, while Boosey (1887) found that trout were used as food. An examination of twenty-two specimens of *E. lucius* by Marshall and Gilbert (1905) revealed a heavy piscine diet, consisting largely of minnows. Likewise Hankinson (1908, 1916) and Reighard (1915) found fish a common source of food. Baker (1916) found the stomach contents of *E. niger* composed largely of crayfishes, insect larvae, and small fishes. Pearse (1921) found *E. lucius* subsisting largely on a piscine diet. Forbes and Richardson (1920) examined several specimens of *E. americanus* and *E. lucius*, and found the food of the smaller ones consisted largely of tadpoles, minnows, aquatic insects and crustaceans; the larger ones, of several species of fishes, of crayfishes, mice, reptiles, and young ducks. Clemens (1924) observed fish remains, a shrew, and leeches as the stomach contents of twenty-three specimens of *E. lucius*. Adams and Hankinson (1928), Greeley (1930), Rimsky-Korsakoff (1930), Sibley and Rimskey-Korsakoff (1931), Greeley and Bishop (1932), Pate (1933) and McNamara (1937) have contributed further data to this subject.

This paper attempts to: (1) present our records on the food of Connecticut pickerel and (2) summarize all available data on the food of pickerel including our own findings.

Food of Pocotopaug Pickerel.—Over thirty specimens of pickerel (*E. niger* and *E. americanus*) were taken during late summer and early fall from a slow flowing estuary of Lake Pocotopaug, East Hampton, Connecticut. The area is shallow, weedy and very rich in plankton, snails, crayfishes and insect larvae (fig. 1).

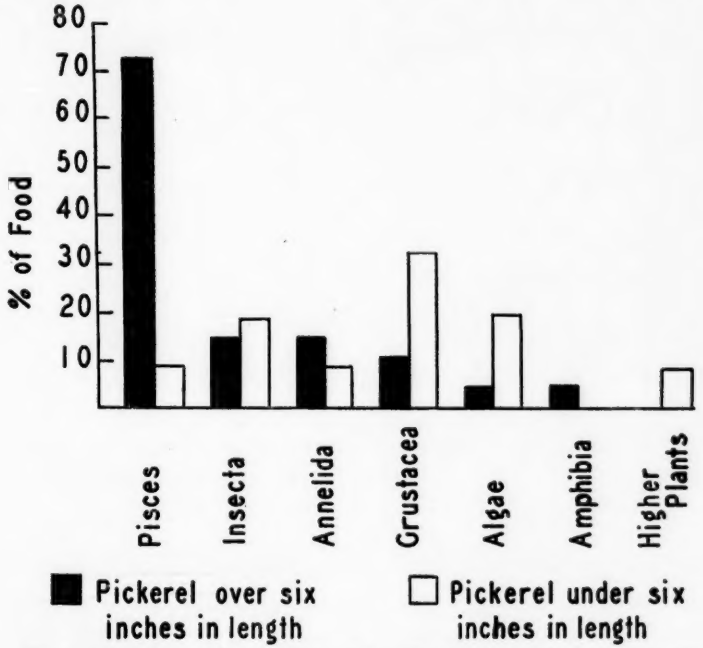

Fig. 1. Comparison of foods of large and small pickerel in Lake Pocotopaug, East Hampton, Connecticut.

In all of these studies it was possible to divide the fish into two groups on the basis of their diet as indicated through an examination of their stomach contents: the young, those under 6 inches in length, and the older group, those over 6 inches long. This is of course an arbitrary grouping.

Reference to figure 1 shows that the younger group of pickerel fed more on Crustacea than on any other kind of organism. Algae and insects ranked next in importance. Remains of the higher plants, fish, and annelid worms were about equally represented at approximately 10 per cent each. The proportions differ somewhat from those listed on figure 2, which summarizes all data available to us including those from Pocotopaug pickerel.

The above study clearly indicates that dietary differences exist between young and adult fish even when both are taken from the same restricted body of water in which they apparently live their entire lives.

General Summary of the Food of Pickerel.—As seen from the above paragraphs the food habits of young and older pickerel differ rather markedly

when taken from the same locality. Bringing together our findings on the two species of Pocotopaug pickerel and making a grand summary of all data available to us, one obtains some striking differences in diet between young and old pickerel. While figure 1 is based upon data secured from *E. niger* and *E. americanus*, figures 2 and 3 include Connecticut and other data on *E. lucius* as well.

SPECIES OF FISHES EATEN BY PICKEREL, COMPILED FROM PRESENT DATA AND FROM THE LITERATURE

21.7 per cent of the food of pickerel under six inches were fish remains classified as follows:

Catostomidae—0.18%
Catostomus commersonnii
Cyprinidae—5.69%
minnow fragments
Notropis atherinoides
Notropis cornutus
Notropis deliciosus
Notropis hudsonius
Rhinichthys atronasus
Rhinichthys cataractae
Hyborhynchus notatus
Notemigonus chrysoleucas
Ameiuridae—0.18%
Ameiurus nebulosus
Umbridae—0.36%
Umbra limi
Esocidae
Esox niger
Cyprinodontidae
Fundulus d. menona
Percidae—3.7%
Perca flavescens
Centrarchidae—2.81%
Eupomotis gibbosus
Ambloplitis rupestris
Micropterus dolomieu
Gasterosteidae—0.36%
Eucalia inconstans
Gasterosteus aculeatus
Hiodontidae—0.18%
Hiodon tergisus
Etheostomidae—2.58%
Boleosoma olmstedi
Boleosoma nigrum
Percina caproides
Fish fry—2.8%

62.4 per cent of the food of pickerel over six inches were fish remains classified as follows:

Catostomidae—0.32%
Catostomus commersonnii
Cyprinidae—21.8%
Notemigonus chrysoleucas
Notropis cornutus
Notropis hudsonius
Notropis volucellus
Notropis whipplii
Hyborhynchus notatus
Rhinichthys cataractae
Ameiuridae—0.32%
Ameiurus nebulosus
Umbridae—0.13%
Umbra limi
Esccidae—0.58%
Esox niger
Cyprinodontidae—0.26%
Gambusia sp.
Fundulus d. menona
Percidae—6.7%
Perca flavescens
Stizostedion vitreum
Centrarchidae—1.17%
Lepomis incisor
Micropterus sp.
Ambloplitis rupestris
Eupomotis gibbosus
Etheostomidae—0.91%
Percina caproides
Boleosoma olmstedi
Cottogaster sp.
Salmonidae—0.18%
trout
Cottidae—0.19%
sculpin
Clupeidae—0.13%
alewives
Osmeridae—0.32%
Osmerus mordax
Percopsidae——0.13%
Percopsis omiscomaycus
Undetermined fish remains—29%

A compilation of the data indicates that in young pickerel (under 6 inches) insects constitute the main item of diet, forming 67.4 per cent of the total intake of 194 small pickerel. These insects consist of chironomids, Odonata, Ephemerida, Culicidae, Hemiptera and Trichoptera. Young pickerel, as they grow older, start preying upon other fishes, for this item even

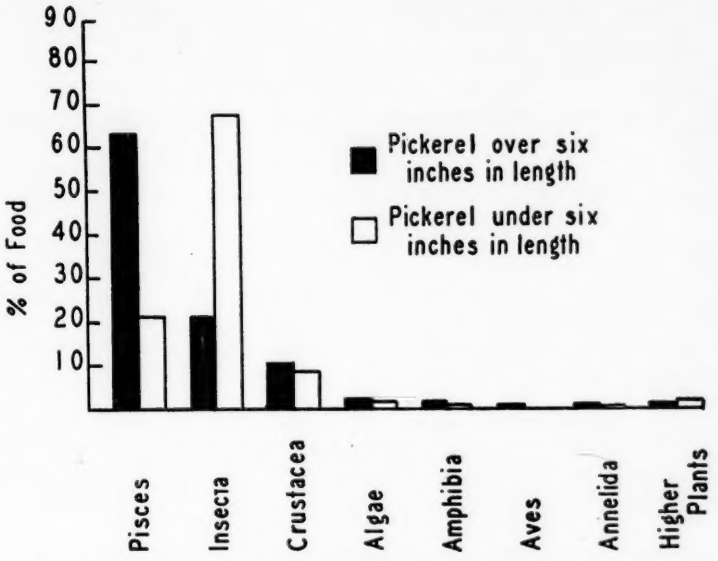

Fig. 2. Comparison of foods of large and small pickerel as found in the literature.

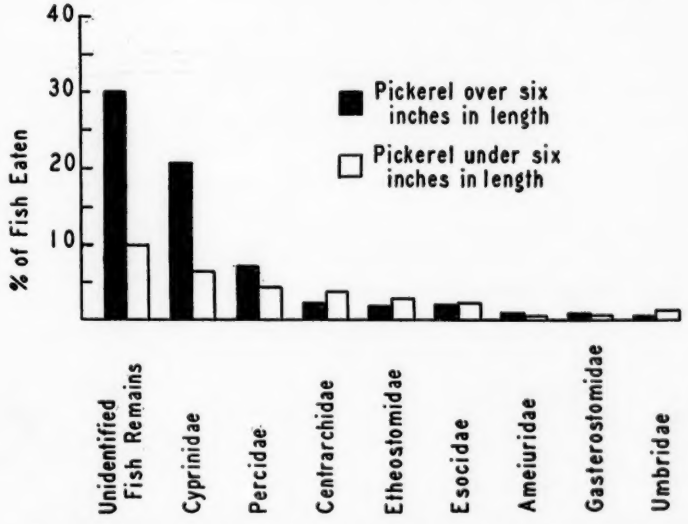

Fig. 3. Comparison of families of fish eaten by large and small pickerel as recorded in the literature and by the writers.

in young fish, constitutes about 21.7 per cent of their diet. Crustacea (the type depending upon the size of the fish) make up 7.84 per cent of their food.

The 247 older fish as reported by various authors are, however, primarily piscivorous, for 62.4 per cent of their food belongs to this group. Thus fish and insects change places in the menu of young and older pickerel. Little difference is noted in the other dietary items, including the Crustacea (fig. 2).

For the sake of completeness the various families of fishes as represented in the esocid diet are summarized in figure 3. Further details appear in the table which lists the species of fish taken.

It is well recognized that a study of stomach contents of fishes does not give a thoroughly satisfactory picture of the entire situation. While it is desirable to correlate such studies with the available food in a given environment, it is not always possible to do so. It was impractical to make this correlation in the Connecticut area, and as the estuary closely simulates a small pond it was not a necessity. The water level at the stream mouth is maintained by the lake. Connection between the two comes through two 12 inch pipes passing under the road. As pickerel of all ages were present, and were taken in all collections it is assumed that both the young and older fish had access to the same types and quantities of food organisms. Hence figure 1 really indicates a degree of selection of food on the part of the pickerel.

Summary

Data collected from a small restricted area flowing into Lake Pocotopaug indicate striking differences in the food items selected by two species of young and older pickerel (*E. niger* and *E. americanus*). A grand summary of the data on the food of pickerel is tabulated. Here again marked differences occur.

Literature Cited

Adams, C. C. and T. L. Hankinson
1928 The ecology and economics of Oneida Lake fish. *Roos. Wild Life Ann.*, 1: 388-396.

Baker, F. C.
1916 The relation of mollusks to fish in Oneida Lake. *N. Y. State Coll. Forestry*, Tech. Bull. 4: 1-366.

Birge, E. A.
1929 Fish and their food. *Trans. Amer. Fish Soc.*, 1929: 188-194.

Boosey, T.
1887 Anecdotes of fish and fishing. London: 250 pp.

Clemens, W. A., J. R. Dymond, and N. K. Bigelow
1924 Food studies of Lake Nipigon fishes. *Univ. Toronto Stud. Biol. Ser., Publ. Ontario Fish. Res. Lab.* No. 25: 103-165.

Forbes, S. A., and R. E. Richardson
1920 The fishes of Illinois. *State Ill. Nat. Hist. Surv.*, 2nd ed.: 1-357.

Greeley, J. R.
1930 Fishes of the Lake Champlain watershed. *New York Cons. Dept., Biol. Survey*, 1929: 44-87.

Greeley, J. R. and S. C. Bishop
1932 Fishes of the Oswegatchie and Black River systems. *Ibid.*, 1931: 54-93.

Hankinson, T. L.
1908 Biological survey of Walnut Lake, Michigan. *Mich. Rep. Geol. Surv.*: 157-271.

1916 Results of the Shiras Expeditions to Whitefish Point, Michigan: Fishes. *Mich. Geol. and Biol. Surv.*, Publ. 20, Biol. Ser. 4: 111-170.

McNAMARA, F.

1937 Breeding and food habits of the pikes, *Esox lucius* and *Esox vermiculatus*. *Tr. Amer. Fish. Soc.*, 66: 372-373.

MARSHALL, W. S. and N. C. GILBERT

1905 Three new trematodes found principally in black bass. *Zool. Jahrb., Syst.* 22: 447-488.

PATE, V. S. L.

1933 Studies on fish food in selected areas. *State N. Y. Cons. Dept., Biol. Surv.*, 1932: 130-156.

PEARSE, A. S.

1921 The distribution and food of the fishes of three Wisconsin lakes in summer. *Univ. Wis. Stud. in Sci.*, 3: 1-61.

REIGHARD, J. E.

1915 An ecological reconnaissance of the fishes of Douglas Lake, Cheboygan County, Michigan, in mid-summer. *U. S. Bur. Fish. Bull.* 33: 215-249.

RIMSKY-KORSAKOFF, V. N.

1930 The food of certain fishes of the Lake Champlain watershed. *New York Cons. Dept. Biol. Surv.*, 1929: 88-104.

SEELEY, H. G.

1886 The freshwater fishes of Europe: 360-366.

SIBLEY, C. K., and V. RIMSKY-KORSAKOFF

1931 Food of certain fishes in the watershed. *New York Conserv. Dept. Biol. Surv.*, 1930: 109-120.

WEED, A. C.

1927 Pike, pickerel, and muskalonge. *Field Mus. Nat. Hist.*, Zool. Leaflet 9: 1-52.

SHANULIN LABORATORY OF BIOLOGY, WESLEYAN UNIVERSITY, and DEPARTMENT OF BIOLOGY, AMHERST COLLEGE, AMHERST, MASSACHUSETTS.

A New *Henicichthys* from the Philippines

ALBERT W. C. T. HERRE

IN 1915 Dr. S. Tanaka described in Japanese a new family, Henicichthyidae, which he proposed for the genus *Henicichthys*, containing a new species, *Henicichthys foraminosus*.

In *A Classification of Fishes*, published by David Starr Jordan in 1923, he places the family Henicicthyidae after the Cepolidae and before the Trichodontidae. He gives also an English translation of the original description, written by Mr. Tanaka.

The only other published record is by Tomiyama, a student of Tanaka's. In his paper on the Gobiidae of Japan (Japanese Journal of Zoology, 7, 1936: 37-112, fig. 9), Tomiyama places *Henicichthys* in the Gobiidae. He describes four specimens 35 to 60 mm. in length, from as many Japanese localities.

In 1929 Dr. Carl L. Hubbs collected specimens in Japan, but nothing has been published about them.

In conversation, and also in a letter Dr. Hubbs states "The possible relationship to the gobies has occurred to me from the first, but I am very sceptical indeed. Even though the genus might be related to the gobies, I think it should still be regarded as representative of a distinct family."

Henicichthys seemed when first examined to be too different from any gobioid fish known to me to be placed with the gobies. In this opinion my colleague, Dr. George S. Myers, likewise concurs. Until ample material, both mature and juvenile, and the osteological characters have been studied, it is certainly inadvisable to call *Henicichthys* a gobioid fish.

As *Henicichthys* was known only from Japan, it was a very welcome surprise to obtain another species from the Philippines on my visit there in December, 1936.

Henicichthys ***philippinus,*** new species

Dorsal VI–I–9 or II–8; anal II–8; ventral I–5; branchiostegals 7. The gill opening is large, extending forward beneath the middle of the eye. The compressed body is entirely naked. An intricate net work of mucus sensory pores covers the head and trunk, much like that shown in Tomiyama's figure of *Henicichthys foraminosus* Tanaka, but differing in details of arrangement and numbers.

The depth is 3.75 to 4.10, the head about 2.5, the caudal 3.1 to 3.3 times in the length. The eye is 4.4 to 5, the snout 3.7 to 3.9, the interorbital 4.4 to 4.5, the maxillary 1.9 to 2 times in the head.

The head is large, with prominent snout, the lower jaw slightly included, the large mouth extending to beneath the hind margin of the eye, or beyond; the lower jaw is curved so that its tip is somewhat separated from the rest. The teeth of the upper jaw are in one row, with a median space at the tip, and a group at either side more or less enlarged. The lower jaw may have two rows of teeth at its tip, but nearly always has but one row with enlarged, fang-like teeth just back of the indentation near the tip. On the vomer is a transverse row of two to four short strong pointed teeth and behind it on the middle of the vomer is a very large pointed tooth that is produced from two teeth coalescing into one. There is a row of small strong teeth on each palatine bone.

The fins are all low; the height of the first dorsal is 3.75, that of the second dorsal 2, the anal 2.25, the long broad pectoral 1.3, the ventral 2.25 times in the head.

The color of preserved specimens is pale tan or very pale roseate, with a bluish opalescence; the eyes pearly or black. In life this species is translucent and more or less rose color, with a bluish pearly lustre, and brilliant pearly eyes.

The type, 31 mm. long, and four paratypes down to 27 mm. in length, were taken from a tide pool at Nasugbu, Bantangas Province, Luzon; four paratypes 20 to 28 mm. long were taken from a tide pool at Dumaguete, Oriental Negros.

NATURAL HISTORY MUSEUM, STANFORD UNIVERSITY, CALIFORNIA.

Some Phases of the Life History and Relationships of the Cyprinid, *Clinostomus elongatus* (Kirtland)[1]

By William J. Koster

While Stuart M. Brown, Jr., and I were fishing in a small stream south of Ithaca, New York, on May 16, 1936, we found ripe males and nearly ripe females of the red-sided dace, *Clinostomus elongatus* (Kirtland). Realizing that the life history of this species was practically unknown, studies were made of its spawning habits and related phenonoma. The stream, Danby Creek, which drains into the Susquehanna River, flows through low open pastures and alder thickets. It is a typical small creek of the upland pool and riffle type having a bottom composed largely of rubble, with some slab-boulders and occasional small areas of gravel. The width and depth vary considerably. At the area studied, about one-half mile northwest of the Tompkins-Tioga County line, the width ranges from about 2 to 6 meters (6 to 20 feet); the depth in the riffles varies from 5 to 10 centimeters (2 to 4 inches) and in the pools from somewhat less than a third to slightly over a meter (1 to 3½ feet).

The red-sided dace is fairly common in some of the pools, especially those in the cleared areas where they are associated with common suckers, *Catostomus c. commersonii;* horned dace, *Semotilus a. atromaculatus;* black-nosed dace, *Rhinichthys a. atratulus;* common shiners, *Notropis c. cornutus;* pearly minnows, *Margariscus m. margarita;* stone-roller minnows, *Campostoma anomalum;* margined stone-cats, *Schilbeodes insignis;* Johnny darters, *Boleosoma nigrum olmstedi* and sculpins, *Cottus b. bairdii.* The suckers, horned dace, black-nosed dace, and common shiners are the most prevalent forms.

Because the red-sided dace are neither especially numerous nor uniformly distributed in the stream, a survey was made to locate as many of the schools as possible in order to find the most advantageous places for study. The activities of about three of the schools which were most favorably situated were followed closely while those of others were checked once every day or two. Gravelly areas were also noted because the rather high frequency of hybridization between this fish and the common shiner or the horned dace seemed to indicate that they frequently spawned in the proximity of spawning pairs of these species which deposit their eggs in gravel.

The region studied in greatest detail consisted of a more or less h-shaped area in which the vertical portions of the 'h' were pools and the horizontal portion a riffle. The standard of the 'h' consisted of a long shallow pool about 3 decimeters (1 foot) deep which drained at its side across a gravel bed at the end of which came the riffle proper. The lower end of the riffle was deflected so that the succeeding pool lay parallel with the lower end of the upper pool. The bottom was mostly rubble mixed with some gravel in all parts except about the first half of the horizontal region of the 'h' where it consisted almost entirely of fine gravel mostly less than 1½ centimeters (½ inch) in diameter. The depth was about 3 to 8 centimeters (1 to 3 inches)

[1] This work was done at Cornell University.

and the current was moderately strong over this latter area but the water surface was smooth, permitting ready observations.

By taking up a position on the inside of the turn opposite the gravel area I was able to see all of that territory, part of the upper pool and also the riffle. The details, particularly in the more distant portions of the pool, were observed with binocular field-glasses. Except where part of the activities took place in the upper pool or in the riffle, the greater portion of the activity of the four species mentioned below was confined to that half of the gravel lying on the inside of the turn. All four species spawned within a few centimeters of me.

Since hybrids between the red-sided dace and the common shiner and also the horned dace are not infrequent, it follows that the spawning seasons of these fishes must fall sufficiently close to each other as to overlap, at least occasionally. In 1936, *Clinostomus elongatus* spawned at the same time as *Rhinichthys a. atratulus, Notropis c. cornutus* and *Semotilus a. atromaculatus*. After the cold spell of May 18–19 during which time no fish was seen to spawn, the black-nosed dace, the common shiner, the horned dace, and the red-sided dace were first seen to spawn on May 22, 24, 25 and 26 respectively. By June 2, the spawning season of all four species was definitely on the wane. On that date the males of *Clinostomus* were still shedding milt but the females contained very few if any eggs. The males therefore were known to have been ripe for seventeen days whereas the females were functional for somewhat less than half that period.

The red-sided dace is primarily an inhabitant of pools where it spends its active hours securing a large portion of its food from or near the surface, often jumping several centimeters into the air to catch a hovering insect. With the close approach of the spawning season, the adult male dace tend to leave the pools and approach the spawning beds, especially during the middle of the day. They are followed shortly after by the females. At first the fish are chiefly concerned with foraging, later they become more interested in the reproductive activities and still later they replace the emphasis upon feeding. This is true both as a seasonal and as a daily succession. No evidence of other than local migrations to spawning beds was noted. In the area most intensively studied, most of the *Clinostomus* foraged in the upper pool and moved downstream to the gravel patch for spawning.

Three days before actual spawning was observed, two signs of its proximity took place at irregular intervals. First, if a female ventured near to a male or a group of males while on the gravel patch, or even occasionally while in the pool, she was pursued with great vigor by one to ten of them who would follow her from the gravel where the chase usually began in and about the upper pool. The distance covered in these pursuits varied from somewhat less than a meter to many meters in which case the female had zig-zagged over all the immediate area. Usually the males dropped out when the female reached the pool but on one occasion two males caught up with a female for a fraction of an instant near the lower end of the pool. Each of them came close to her, one on either side. While many other pursuits were observed, in none of them were the males ever so close. They were usually several centimeters behind the tail of the female at all times. The second sign of the

approaching season was the defense of small territories by the males. These were usually selected behind the horned dace redd with the greatest amount of activity taking place within it. The guarded areas were poorly defined and small, being but a few centimeters in each direction. Correlated with this tendency to claim certain areas was the occurrence of combats or, rather, deferred combats between the males, for the fish were never seen actually to fight. The two contestants for a particular site would swim off side by side in a stiff fashion as described by Reighard (1920) and later by others for various species. At the end of this intimidation swim which was sometimes 2 to 3 meters (7 to 10 feet) long, the pair would separate without coming to blows and return to the area in question which as likely as not had been taken by some other male. As the actual spawning period approached, the territorial instinct became weaker and finally was practically absent. As they became more interested in spawning, the adult dace congregated in dense schools rather closely behind the pits of the more actively guarded horned dace redds, which, however, were sometimes in the possession of common shiners. The males formed the body of the group, with the females restricted to the posterior and lateral margins. From time to time a female would leave her position at the margin of the school and swim toward the pit of the horned dace redd. In this event the males would join her on the way and they would then spawn in the depression of the redd. In the simplest case, there would be a single male on either side of the female, each with his body as close as possible to hers while they were in the pit. The sex products are apparently emitted at this time. In the more complex cases which were also more common, there would be a group of several—four to six, or even more—males gathered dorsally and laterally about the female much as Reighard (1920) has described and figured for the black sucker. The course taken by the spawning group was upstream into the pit of the horned dace redd, occasionally passing along the inside near the lateral margins but usually progressing just above the bottom straight through the middle of the depression to its anterior edge where the group broke apart and the individuals drifted downstream to rejoin the main school. On a number of occasions the spawning act was repeated four to six times within the space of one minute, but usually several minutes elapsed between successive matings. Whether these series each represented the efforts of one or of several females could not be determined. The lowest temperature at which spawning was observed was 18° C. (65° F.).

Competition of the males for the females seemed to be largely restricted to getting and maintaining a suitable position next to them. No combats, deferred or otherwise, were observed after the fish actually began spawning. Therefore, at least theoretically, the more active and agile males should have the greatest opportunity for successful matings as Smith (1908) has found for *Chrosomus erythrogaster*, but no data were secured regarding this point. While at any given mating, the relation of the sexes is polyandrous, the ultimate condition is promiscuity since, during any given season, each individual spawns a number of times with several different partners.

The reaction of the male horned dace and shiners to the spawning red-sided dace was one of tolerance. At one time a spawning group of *Clinostomus*

actually pushed a fairly large male *Semotilus* aside without provoking an attack. The red-sided dace were often driven away from the tail of the redd during the battles for the possession of the redds by the horned dace and shiners but were not made the object of special persecution.

Sexual dimorphism in *Clinostomus elongatus* appears to be a matter of degree rather than of kind. As is mentioned below, the sexes mature at about the same size but the females ultimately outstrip the males in growth. In a collection of twenty-seven adults which included eleven males and sixteen females, the fins of the males all averaged somewhat higher than those of the females. The pectoral fin, however, was the only one that exhibited a striking dimorphism between the sexes, being larger and thicker in the male than in the female. The ratio of standard length to the pectoral height was 4.70 ± 0.14[2] in the males and 5.72 ± 0.21 in the females. The difference is mathematically significant. The adult male red-sided dace in breeding color is a beautiful creature. The top of the head and body are a dark olive except for a lighter mid-dorsal streak extending from the nape to the root of the caudal. A narrow greenish yellow stripe extends from the upper portion of the eye to the caudal base. A black band extends from the snout, including the premaxillaries and chin, through the eye and along the sides to the end of the tail fin. The portion on the head and that on the body posterior to the dorsal fin is intense while the region from the gill openings to a vertical from the end of the dorsal base is largely replaced by red. The parts ventrad to a level with the bottom of the pupil are white. The iris is black laterally, yellowish above and along the inner margin and whitish below. The dorsal and caudal fins are olive buff; the pectorals are dusky along their anterior margins but clear posteriorly, while the ventral and anal fins are clear. The colors in Miss Edmonson's (1927) excellent painting are somewhat less intense and brilliant than those of a fish about to spawn.

Before the actual spawning season, the female is rather similar to the male except that the red along the side is inconspicuous or absent. However, while the fish are on the spawning beds, the females also have red sides. The red on the side of the females also shows up when the fish is preserved in formalin, a condition that Breder (1920) found to be true for *Clinostomus vandoisulus*. It may be that the females of this latter species are also red-sided during actual spawning. The colors in the two sexes, while very similar, are not identical, as those of the male are more intense and vivid. The sexes may be distinguished in the field by the lighter colors, swollen abdomen, timid movements and apparent absence of pearl organs in the female. These latter are numerous and stand out quite white against the dark olive background of the upper parts of the male. In the more fully developed males, they are distributed over almost the entire animal. Females likewise develop nuptial tubercles, but these are smaller and less widely distributed than those of the males. However, the distribution of pearl organs on the most highly developed females exceeded that of the more poorly developed males.

Since the published descriptions (Hubbs and Brown, 1929; Hubbs and Cooper, 1936) of the distribution of pearl organs appear to be based on males showing a considerably lesser degree of development than those encountered

[2] Standard deviations used throughout.

during this study, the following description is included: The entire animal is more or less covered with small, often minute, pearl organs. These are largest and whitest on the dorsal surface of the head, body and pectoral fins. Scattered amongst the larger tubercles are small, inconspicuous ones. The entire head, except, of course, the eyes and nostrils, but including the lips and branchiostegal rays, is covered with small erect tubercles. Practically every scale on the body bears a single erect pearl organ on its margin while some of the scales along the side, particularly in the red area, may bear several.

On the breast near the base of the pectoral fin is a roughly triangular patch of scales which bear along their apical margins one to several more or less enlarged pearl organs which form a series of irregular rows. Nuptial tubercles are developed on both surfaces of all the fins but those on the lower surface of the paired fins are rather smaller than the rest. Each ray of the dorsal and anal fins except the first rudimentary one and the last have a series of erect pearl organs along most of their distal two-thirds. There is a peculiar thinning-out or absence of tubercles in the region of the second bifurcation of each ray of both fins. Some tubercles are found scattered on the caudal rays, particularly the middle ones. The dorsal surface of each ventral fin ray except the last bears a series of tubercles for most of its length. On the ventral surface, the pearl organs are restricted to the anterior branch of each ray. The dorsal surface of the first ten rays of the pectoral fins are antrorse tuberculate. The spines on the first seven rays are best developed. Small tubercles are found scattered along the ventral surface of many of the rays.

The striking feature in the disposition of the pearl organs other than their presence on the female and their very general distribution on the more highly developed males, is the presence on the breast of an arrangment that is highly suggestive of the peculiar condition found in *Pfrille* and *Chrosomus*. In each of these genera there is developed a series of "very regular comb-like rows of nuptial organs" on the breast just anterior to the pectoral fin. Hubbs and Brown (1929) who first called attention to this feature considered it evidence of direct relationship between these genera and were unable to find anything even suggestive of this arrangement in other genera. *Clinostomus* differs from *Chrosomus* (as exemplified by a specimen of *C. erythrogaster* in the Cornell University Museum) in having fewer but relatively larger nuptial tubercles on each scale in the areas concerned, and these not in such definite rows. A very similar condition was found in a specimen of *Clinostomus vandoisulus* from North Carolina and in a small series of ripe male *Margariscus m. margarita* from near Ithaca, New York. The individual tubercles were smaller and the rows somewhat more regular in *Margariscus* than in the two species of *Clinostomus*. While the arrangements found in *Clinostomus* and *Margariscus* are very similar and are probably evidence of direct relationship, that of the latter more closely approaches the pattern of *Chrosomus*. The color pattern of ripe male *Margariscus m. margarita* is strikingly similar to that of *Clinostomus elongatus*, and offers further evidence of the close relationships between these genera. Still other similarities are apparent by reading the redescription of the two genera in the account of

Hubbs (1926). If the arrangement of pearl organs as found on the breast of the red-sided dace is but a variation of the similar structure of the red-bellied dace, then the two groups, *Chrosomus-Pfrille* and *Margariscus-Clinostomus* form a closely related series.[3]

Langlois (1929) studied the spawning habits of the northern dace, *Margariscus margarita nachtriebi* Cox, and found that the typical behavior of this species was for each male to maintain, or attempt to maintain, a small territory from which other males were excluded and in which he did most or all of his mating. During the spawning act proper the pair comes to rest on the bottom; the male slips his enlarged pectoral fin under the breast of the female, places his tail over her back just behind the dorsal fin and as he lifts her head end up and presses her vent and tail into the gravel they vibrate together apparently as the sex products are emitted. Smith (1908), working on *Chrosomus erythrogaster,* found that instead of being hostile to each other and maintaining a territory, the males co-operated so that two or more would mate simultaneously with the same female. The spawning group typically consisted of three individuals, a female with a male closely appressed on either side. This position was assumed either in the open water or in the extreme shallows. The eggs and milt are emitted during periods of vibratory motion while in this position. Competition amongst the males was restricted to an attempt to secure a position next to the female so that the original group of three was sometimes attended by other males attempting to crowd in. Two variations from the usual behavior pattern were noted by Smith. On one occasion a female was seen to mate with a single male who crowded her against the bottom and curved his tail over her body in a manner similar to that later described by Langlois for the northern dace. The other departure from the customary involved a group of about a dozen males that had taken up a position in an abandoned horned-dace redd which "was evidently an especially favorable place for spawning." The arrival of a female created great excitement amongst the males, which "crowded around her, pressing along side and against her in the hollow of the nest."

Morphologically, *Clinostomus* appears to have more in common with *Margariscus* than with *Chrosomus,* but its spawning habits are apparently a specialization of the condition found in the latter. The prenuptial activities described above show similarities to the definitive stage in each of the last named genera. The tendency of the males to maintain territories resembles the habits of *Margariscus* while the male habit of pursuing females resembles the behavior of *Chrosomus.*

The exception, noted above, to the general statement that the males were behind the females at all times during the prenuptial pursuits of *Clinostomus* may have been an actual mating, although this could not be determined in spite of good visibility. As the actual spawning season got under way and the instinct for patrolling a territory became suppressed, the general behavior became more like that of *Chrosomus.* The one variant in the spawning behavior of *Chrosomus* as recorded by Smith is rather similar to the normal

[3] *Couesius plumbeus* must apparently be added to this group. Specimens collected by Dr. Theodore T. Odell in Willoughby Lake, Vermont, differ from *Chrosomus* and resemble *Margariscus* in the less regular rows but resemble the former in that each scale bears several (up to about ten) small tubercles along its apical margin.

condition as found by Langlois in the northern dace, while the other variant, that of a group of males spawning with a female in the pit of a horned-dace redd, is very close to the condition found in the red-sided dace.

Hybrids between *Clinostomus elongatus* and either *Notropis cornutus* or *Semotilus a. atromaculatus* are not uncommon. Greene (1935) found about 2% of hybrids in a series of thirty-one collections totalling approximately 600 specimens. The relative frequency of these hybrids leads one to wonder about their conception. Nothing was seen at any time that even remotely suggested direct crossmatings. The crowded conditions where many individuals of four species were utilizing the same patch of gravel for spawning purposes during the same period of time, and where it took but five or six seconds for the water to traverse the greatest diameter of the area seemed conducive to the production of hybrids provided that the sperm of the species involved could fertilize eggs of another species after being several seconds in the water.

Because of the spottiness of its distribution, Greene (1935) has suggested that *Clinostomus elongatus* is in the process of extinction, and that its hybridization is "simply—an aspect of competition" in which the more tolerant shiners and horned-dace are absorbing the less tolerant red-sided dace. If, as the above observations indicate, the red-sided dace are largely or entirely restricted to spawning in horned dace or common shiner redds, an additional hypothesis may be advanced. It may be that the red-sided dace have become over-specialized in their spawning habits and that the spottiness of their distribution is evidence that they are not fully synchronized with the host species as regards season of spawning.

Eggs which had been stripped from the females and mixed with milt were allowed to stand for several hours to allow complete water-hardening. At the end of this period they were slightly yellowish in color, spheroidal or somewhat ovoidal in shape and 1.2–2.4 mm. in diameter. They were not adhesive at any time. Efforts to carry them through to the larval stages were unsuccessful. The number of eggs produced by a single female as determined by direct count made on fifteen specimens collected just before the eggs became fully mature varied from 409 to 1526, the number apparently varying more with age than with size.

By the examination of the scales of the specimens in two random collections, one made in May, the other in October, some idea was obtained of the age of maturity, rate of growth and longevity although the scales were difficult to read, as Breder (1920) had found for the other member of the genus, *C. vandoisulus*. Conclusions made on the basis of scale readings were checked as far as possible by plotting the length distributions without reference to scale determinations.

According to the available evidence, both sexes usually spawn for the first time after having passed through two winters. Breder (1920) came to a similar conclusion regarding *C. vandoisulus*. At the end of one year a few of the more precocious individuals showed a slight enlargement of the gonads but not enough to consider them adult, while others, more tardy, were still immature after having passed through two, and in one female, three winters. The oldest specimens of both sexes were in their fourth year

of life when captured. They apparently spawn every year after reaching sexual maturity.

The mean standard length of specimens in the May collection that were almost one year old was 38.0 ± 2.5 mm. for eight males and 37.3 ± 2.8 mm. for seven females; that of six males nearing two years of age was 55.6 ± 2.9 mm. and of ten females, 57.0 ± 2.7 mm. The males at the end of the third winter averaged 61.7 ± 3.4 mm. (five specimens) while eight females of the same age were 69.1 ± 3.2 mm., a difference of 7.4 mm. which is probably of statistical significance. Only three specimens of the four-winter group were available, one male of 65 mm. and two females averaging 76.5 ± 3.2 mm. The largest specimens seen during the course of this study had a standard length of 71.0 mm. (2.8 in.) and 79.0 mm. (3.1 in.) and a total length of 89.0. (3.5 in.) and 97.5 mm. (3.8 in.) for the males and females respectively. These are larger than the maximum of 3⅜ inches given by Fowler (1909) but less than that of 4 inches given by Jordan (1929) or that of Jordan and Evermann (1896) of 5 inches.

Literature Cited

Breder, C. M., Jr.
1920 Some notes on *Leuciscus vandoisulus* (Cuv. and Val.). Copeia, 1920: 35–38.

Edmonson, Ellen
1927 Color plate I. In: A biological survey of the Genesee River system. *New York Cons. Dept. Suppl. to 16th Ann. Rept.*, 1926 (1927).

Fowler, Henry W.
1909 A synopsis of the Cyprinidae of Pennsylvania. *Proc. Acad. Nat. Sci. Phila.*, 60, 1908 (1909): 517–553.

Greene, C. Willard
1935 The distribution of Wisconsin fishes. *State of Wisconsin, Conservation Comm.*, 1935: 1–235.

Hubbs, Carl L.
1926 A check-list of the fishes of the Great Lakes and tributary waters, with nomenclatorial notes and analytical keys. *Univ. Mich., Mus. Zool., Misc. Publ.*, 15: 1–77, 4 pls.

Hubbs, Carl L., and Dugald E. S. Brown
1929 Materials for a distributional study of Ontario fishes. *Trans. Royal Canad. Inst.*, 17 (1): 1–56.

Hubbs, Carl L., and Gerald P. Cooper
1936 Minnows of Michigan. *Cranbrook Inst. of Sci. Bull.* 8: 1–95, 10 pls.

Jordan, David Starr
1929 Manual of the vertebrate animals of the northeastern United States inclusive of marine species. 13th ed. *World Book Co., New York*: xxxii+446.

Jordan, David Starr, and Barton Warren Evermann
1896 The fishes of North and Middle America. *Bull. U. S. Nat. Mus.* 47, part 1: lx + 1240.

Langlois, T. H.
1929 Breeding habits of the northern dace. *Ecology*, 10 (1): 161–163.

Reighard, Jacob
1920 The breeding behavior of the suckers and minnows. *Biol. Bull.*, 38 (1): 1–32.

Smith, Bertram G.
1908 The spawning habits of *Chrosomus erythrogaster* Rafinesque. *Biol. Bull.*, 14 (6): 9–18.

University of New Mexico, Albuquerque, New Mexico.

Egg-Laying of the Slender Salamander (*Batrachoseps attenuatus*)

By Thos. Paul Maslin, Jr.

THE finding on November 5, 1938, of an adult female *Batrachoseps attenuatus* in the act of laying her eggs raised the question as to when normal oviposition of this species takes place. Search in the literature failed to reveal any record of eggs found in the autumn as early as November, or for that matter description of any freshly deposited eggs.

The individual mentioned above was in a small depression in damp soil beneath a strip of tin at the northwest corner of Cedar and Spruce streets, Berkeley, Alameda County, California. The immediate area was shaded by a pepper tree (*Schinus molle*) and some rank weeds in such a way that no sunlight could fall on the spot. In this depression were three other adult female *Batrachoseps attenuatus* and seventy-four eggs. Four of the eggs were attached through the cloacal opening by a string-like gelatinous peduncle to the salamander in the act of laying its eggs. These eggs were in turn attached to each other by similar peduncles, which measured about 12 mm. in length. In addition to the eggs and salamanders, the depression contained small lumps of earth and a little organic material; all this debris, in contrast to the surrounding soil, was dry.

The freshly deposited capsules measured 6 mm. in diameter. The egg proper was 4 mm. in diameter, spherical, and completely unpigmented. The capsule consisted of three layers of jelly: 1) a thin outer layer which was damp and rather tough, but not sticky; 2) a central layer of semi-rigid jelly; and 3) an inner layer of viscous jelly. The colorless outer layer could be removed quite easily from the central layer; but the central and inner layers, both crystal clear, were practically inseparable. The chorion was completely adherent to this inner layer, and within it was a viscous fluid in which the egg floated. The egg rotated slowly when the capsule was inverted. Pressure within the chorion was high, making removal of an intact egg practically impossible. Upon being pierced, the chorion explosively expelled the egg and the fluids within it, and contracted to a small husk about one-quarter its original size.

Most of the seventy-four eggs were separate, with a peduncle on one side and a fragment of the other persisting at the opposite side. Several clusters were present, tangled about small twigs. One such cluster of eight eggs was untangled and found to be a continuous chain; otherwise no part of this cluster was adherent to any other part, or to the twig.

The site of this clutch does not differ essentially from the sites recorded by other observers. Storer (1925: 94) mentions a clutch of fifty-three eggs found March 7, 1920, beneath a plank in a moist springy place in Strawberry Canyon, Berkeley, California. Burke (1911) records clutches found by T. Kimura in January, 1906, partly buried in depressions under rocks on a moist hillside near Palo Alto, California. On January 5, 1907, Burke found a clutch of thirty-five eggs under a log in a moist ravine in the same hills.

This clutch was divided into a group of twenty-one eggs, separated by a distance of 2 feet from a group of ten, while four eggs lay between. Grinnell and Storer (1924: 654) record a find at Snelling, Merced County, California, in a log lying in river-washed debris, January 8, 1915.

Discovery of the eggs described above on November 5 not only raised the question as to the date of normal oviposition for this species, but also the question as to how many eggs a single female deposits. Judging by the development of eggs found in January and March, Storer (*op. cit.*) concluded that "egg laying occurs in the latter part of the rainy period." Burke concluded from the arrangement of the clutch of thirty-five eggs found by himself that they had been laid by one female. The accompanying table is the result of an examination of females collected in the counties about San Francisco Bay. The specimens are grouped by months. The average mean precipitation, and number of rainy days per month are based on a forty-four year period. These are from records kept by the Geography Department, and pertain to the University of California campus, Berkeley.

	August	September	October	November	December	January	February	March	April	May	June	July	Totals or Averages
Mean precipitation in inches	.44	.53	1.22	2.45	4.17	5.17	4.20	3.84	1.40	.98	.19	.023	24.613
Average number of rainy days	.25	2.2	4.3	7.0	9.8	11.2	9.9	9.5	5.3	5.0	1.3	.25	66
Number of specimens	0	0	0	10	27	20	9	3	4	1	5	0	79
Number having eggs in ovaries or oviducts	...	...	...	6	2	0	0	0	0	1	5	...	14
Average number of eggs in ovaries	...	...	...	10.8	1	0	0	0	0	13	12.6	...	11.8
Diameter of largest egg in mm.	...	...	...	4.0	4.0	...	...	...	...	1.7	2.0	...	...

Of the fourteen females with eggs, three had fully developed eggs in the oviducts and none in the ovaries. One of these is the individual described above as in the act of laying its eggs. The other two offer anomalies. In one specimen two mature eggs with capsules are locked in a loop in the left oviduct near the cloaca. Apparently they became inverted in the tube before the capsules were produced about them, after which re-orientation for normal oviposition became impossible, due to their increased diameter. The right oviduct and the portions of the oviduct anterior and posterior to the loop are normal, as though oviposition were complete. In the other specimen a single full-sized egg has persisted in the posterior region of the left ovary. The oviducts are similar in appearance to those of other females without eggs collected at the same time. These three specimens are not included in the averages.

The eggs are normally disposed in both ovaries, the numbers varying 3-3 to 12-9. The average number of eggs found in the ovaries of eleven specimens was 11.8. In females collected in November with eggs in the ovaries, the posterior portions of the oviducts are enormously developed, glandular, transparent and turgid with gelatinous secretions. The oviducts in individuals collected in the same month which do not contain eggs are similar but somewhat smaller and firmer. Their appearance suggests recent deposition of eggs. December-taken females have normal ovaries and oviducts, judging from gross anatomy. This condition persists until eggs appear in the ovaries in May, when the oviducts have a slightly glandular appearance.

The table demonstrates that oögenesis begins in May, at about the beginning of the dry season. The eggs probably increase in size through this season, reaching their full development in November, at which time they are deposited. For this locality (Berkeley, California), this is the beginning of the rainy season. By December at the latest, and probably earlier, the eggs are all laid and the genital organs have assumed their normal resting-stage appearance. Of the five specimens from Snelling recorded by Grinnell and Storer on January 8 in association with eggs, my examination showed that four were females. One of these salamanders contained two eggs, which were already invested with their gelatinous capsules, in the left oviduct. The oviducts of the other three females were still much enlarged and glandular. These findings indicate that the time of oviposition varies geographically, probably correlated with the varying rainy seasons and the subsequent persistence of soil moisture.

It seems certain that the eggs develop slowly after oviposition. This is not surprising, as winter temperatures in this area are relatively low. The dates of hatching in laboratories, as recorded by Storer, Burke, and Snyder, cannot be taken as natural dates, for laboratory temperatures are probably considerably higher than those of the natural habitats. It seems probable that in undisturbed eggs the hatching period would be just as variable. The fact that small juveniles of approximately the same minimum size are taken over a period of several months in the spring also points to this conclusion.

Since the average number of eggs in the ovaries of the specimens examined is 11.8 (although large individuals may lay more), the clutch of seventy-four eggs first mentioned in this paper was probably deposited by about six individuals. The clutches recorded by Storer and Burke, consisting of fifty-three and thirty-five eggs, were probably deposited by four and three individuals, respectively. In other amphibians, for example *Hyla regilla*, in areas where ponds are infrequent, many females often avail themselves of a single small pond in which to lay their eggs. Egg-laying habits in *Batrachoseps attenuatus* seem to be analogous; this community-use of sites is probably conditioned by their availability. The vacant lot in which the clutch of seventy-four eggs was found supports an unusually large population of these salamanders.

Of the seventy-nine females examined, the average total length was 99.2 mm., the extremes 71–136 mm. (based on seventy-four specimens; five had damaged tails). The body length, measured from snout to the back of the

hind legs, averaged 41.6 mm.; extremes 32–52. The female having the most eggs, 12–9, measured 117 mm. in total length and 48 in body length. The largest female examined, collected in March, 1929, contained no eggs; it measured 136 and 52 mm. for total and body length, respectively.

Conclusions

1. Oviposition in *Batrachoseps attenuatus* occurs at the beginning of the rainy season. This time varies geographically. In the San Francisco Bay region it is in early November.
2. A single female lays about twelve eggs.
3. One egg-laying site may be utilized for oviposition by several females.
4. The time of hatching is variable; it occurs in the spring.

Literature Cited

Burke, C. V.
1911 Note on Batrachoseps attenuatus Esch. *Amer. Nat.*, 45: 413-414.
Grinnell, J., and Storer, T. I.
1924 Animal life in the Yosemite. *Univ. Calif. Press, Berkeley*: xviii + 752 pp., 62 pls., 65 figs.
Snyder, J. O.
1923 Eggs of Batrachoseps attenuatus. Copeia, 121: 86-88, 2 figs.
Storer, T. I.
1925 A synopsis of the Amphibia of California. *Univ. Calif. Publ. Zool.*, 27: 1-343, 18 pls., 42 figs.

Museum of Vertebrate Zoology, University of California, Berkeley, California.

Mainland Forms of the Snake Genus *Tretanorhinus*[1]

By E. R. Dunn

In attempting to deal with the snake fauna of the Panamá Canal Zone, one is faced with the statement of Barbour and Amaral (1924: 131) that *Tretanorhinus nigroluteus* and *T. moquardi* (both described from the Zone) are synonymous, and with Amaral's later statement (1929: 10-11) that the genus is monotypic. When investigation convinced me that *nigroluteus* and *moquardi* in the Canal Zone differ consistently in range, markings, number of dorsal scales, number of ventral scales, number of caudal scales, number of loreals, and number of prefrontals, I examined as many specimens as possible from the whole range of the genus. This report deals with the mainland forms. The Antillean forms are the subject of a separate report by Mr. G. Congdon Wood (1939: 5–11), but I have examined the material with him, and each of us has had access to the findings of the other.

[1]Contributions from the Department of Biology, Haverford College, No. 45.

For the genus as a whole three groups can be made out. These differ in range, in markings, and in ventral count, as shown below:

	Atlantic drainage, mainland	Antillean	Pacific drainage, mainland
Dorsal markings	Two rows of dots	Crossbars	Three dark stripes
Male, ventrals	133-139	152-162	166-169
Female, ventrals	138-151	154-168	168-177

The analysis of North American mainland forms by Bocourt (1891-5) was correct, and it is a pity that, because of lack of attention to his work, it is necessary for me to repeat it.

I have examined forty-eight mainland specimens, from Ecuador to Panamá on the Pacific side, and from Panamá to Guatemala on the Atlantic side, and have used information concerning eleven additional specimens from these areas but have not examined them. I know of no other specimens.

Jan (1863: 76; 1864: 254) has recorded *Tretanorhinus* from Mexico on the basis of specimens in Milan and in Turin. He refers to the Milan specimens in 1863 by the nomen nudum of *adnexus*. The Milan specimens are called *variabilis* in 1865. The Turin specimens are called *variabilis* in both papers. I have not examined these specimens. No Mexican specimens have been seen and no others have been reported.

Jan (1865, *l.c.*: 247; 1868: pl. 1., fig. 1) reported a specimen from Brazil, in the Hamburg Museum, as *Helicops wagleri*. This has not been examined but the figure and description fit specimens from Cuba in every respect.

Key to Mainland *Tretanorhinus*

A. Dorsal markings three longitudinal dark stripes; ventrals 166 or more; prefrontals one or three (very rarely two); one loreal; preoculars two (very rarely three); Pacific drainage forms, Panamá to Ecuador (one Canal Zone exception)
  B. 21 dorsal scale rows; three prefrontals; caudals in females 74-81; Colombia and Ecuador ..... *taeniatus*
  BB. 19 dorsal scale rows; one prefrontal (rarely two); caudals in females 69-74; Pacific slope Panamá Canal Zone (one from Atlantic, Canal Zone) .. *moquardi*

AA. Dorsal markings two rows of alternating small dots (one Petén specimen with a single row of large dots); ventrals 151 or less; two prefrontals; loreals and preoculars variable; 21 dorsal scale rows; Atlantic drainage
  B. Lowermost two scale rows light; typically with two loreals and two preoculars; Panamá to Honduras ..... *nigroluteus*
  BB. Lowermost two scale rows dark; typically with one loreal and three preoculars; Petén and Belize ..... *lateralis*

Tretanorhinus taeniatus Boulenger

Tretanorhinus taeniatus Boulenger, Ann. Mag. Nat. Hist., (7), 12, 1903: 350.

Type.—Female in Brit. Mus., not examined.

Type locality.—Rio Sapayo, N.W. Ecuador, 450 feet altitude.

Range.—Known only from type locality and Buenaventura, Colombia (Mus. Zool., Univ. Mich.)

Diagnosis.—Markings consist of stripes; 21 dorsal scale rows; three prefrontals; ventrals 168-174; caudals 74-81.

DESCRIPTION.—The first statement in the following description refers to the type in each case: scales 21 (21-19); ventrals (♀) 168-175, caudals 81-74; three prefrontals, one loreal, preoculars 2 (2-3); postoculars 2; temporals 1 + 2 or 2 +3 in both specimens; upper labials 8(8-9), fourth (fourth or fifth) entering eye; nasals in contact behind rostral; 4 or 5 lower labials in contact with anterior chin shields; middorsal dark stripe on vertebral row; lateral dark stripe on row 4 in type, on row 5 in the Buenaventura specimen. Median prefrontal small but apparently perfectly normal; rows of scales below lateral dark stripe white; three ill-defined dark stripes along belly, a median one and one at end of the ventrals.

REMARKS.—The relationships are with *T. moquardi*. I have seen only the MZUM specimen, a female.

Tretanorhinus moquardi Bocourt

Tretanorhinus moquardi Bocourt, Le Naturaliste, (2), 5, 1891: 122; Bocourt, Miss. Sci. Mex., Zool., 3, Sect. 1, 1893: pl. 52, fig. 5; Bocourt, *t.c.*, 1895: 797.

TYPES.—Originally five. Two are now, Paris 3675 alpha and beta. One is A.N.S. 11656, presented by Bocourt to Cope, bearing the erroneous locality "Belize."

TYPE LOCALITY.—"á Panamá" =Panamá City.

RANGE.—Known only from the Pacific side of the Panamá Canal Zone, with a single exception from Ft. Sherman on the Atlantic Side.

DIAGNOSIS.—Markings consist of stripes; 19 scale rows; one prefrontal (two exceptions with two prefrontals); ventrals in males 166-169; ventrals in females 168-177; caudals in males 78-85; caudals in females 69-74.

DESCRIPTION.—Dorsal scale rows 19-17; a middorsal dark stripe on vertebral row; a lateral dark stripe on fourth row; three lower scale rows light; normally one prefrontal; one loreal; two preoculars; ventrals in males (2) 166-169; ventrals in females (5) 168-177; caudals in males (2) 78-85; caudals in females (3) 69-74.

VARIATION.—I have seen two specimens with two prefrontals. One is MCZ 18812 taken in 1924 at Ft. Sherman on the Atlantic side of the Canal Zone, some ten or twelve years after the Canal was opened. The division between the prefrontals is asymmetrical and may be an injury. This, a female, is in all other respects a *moquardi* with 19-17 dorsals, 172 ventrals, 74 caudals, one loreal, two preoculars, and normal coloration. The second specimen is a head from the Panamá Sabanas, in my possession. This has 19 dorsal scale rows, one loreal, two preoculars, and normal coloration. The division between the prefrontals appears perfectly normal.

REMARKS.—I am inclined to think the Panamá Canal responsible for the appearance of this Pacific form on the Atlantic side.

I have seen three of the five types and nine additional specimens. I know of no others. Localities are: Panamá City (type locality, Paris 2, ANS 1); Bruja Pt. (MCZ 1); Panamá Sabanas (ERD 3); Corozal (USNM 1, FMNH 1); Corozal and Ft. Clayton (MCZ 1); Ft. Sherman (only Atlantic side locality, MCZ 1); "Panamá" (AMNH 1).

Tretanorhinus nigroluteus Cope

It is more convenient to treat this species first as a whole, presenting synonymies under the subspecific headings. I have examined thirty-six specimens and eight have been reported but not examined. Fifteen are from the Atlantic side of the Panamá Canal Zone: Colon (ANS 1, USNM 1); Fort Randolph (MCZ 5, USNM 1); Fort Sherman (MCZ 1); France Field (MCZ 1); Gatun (USNM 1); Fort Davis (MCZ 1); Bas Obispo (MCZ 2); Juan Mina (MCZ 1). The last locality is well up the Chagres near Madden Dam. From the same area I know of, but have not examined, the following: the type of *bifrenatus* from Colon; one from Panamá (Günther, 1872); three from Panamá (Boulenger, 1893). It is strange that no specimens are known from the Atlantic coast between the Canal Zone and the mouth of the San Juan River in Nicaragua.

Eleven are from Nicaragua: San Juan del Norte (USNM 2, MCZ 2); one mile from mouth of Rio San Juan (USNM 1); Bluefields (AMNH 2); Pia Creek (AMNH 1); "Nicaragua" (USNM 2); Corn Islands (MCZ 1). Pia Creek is well up the Prinzapolka River.

Three are from Honduras: Progreso (MCZ 1, MZUM 1); Tuloa Cr. Plantation (MZUM 1).

Two are from British Honduras: Belize (USNM 2). I know of the two types of *lateralis* from Belize.

Five are from the Prov. of Petén, Guatemala: Laguna Yalac, Rio San Pedro (MZUM 1), El Paso de Caballo (MZUM 2, MCZ 1); Arroyo Subin near Trinidad (MZUM 1).

I have not seen the type of *intermedius* Rosén from "Central America."

VARIATION.—The ventrals of males are 133-139; average of nineteen, 135.9. There is no significant geographical variation. The ventrals of females counted by me are 138-148 (Günther, 1872, records 151 from Panamá; Boulenger, 1893, records 149 from Panamá); average of twenty-four, 143.1. Panamanian specimens seem slightly higher.

The caudals of males are 63-80, average of fifteen, 74.8, no geographical variation. The caudals of females are 56-68, averge of twenty-two, 61.9, slightly higher in Panamá.

The dorsals are regularly 21-17, reducing by dropping the paravertebrals twice. There are regularly two prefrontals.

The dorsal markings, obscure in adults, are, with the exception of a single specimen, a double dorsal series of alternating dark dots, each occupying approximately a single scale. The exception (MCZ 38583 from El Paso del Caballo, Petén) has oval middorsal spots about three scales long by six wide.

The two lower scale rows are light in color in specimens from Panamá, Nicaragua and Honduras; dark in specimens from Belize and Petén. In the latter there is usually a light line on the third row. In southern specimens the belly is light, with traces of a midventral dark stripe and one on the edges of the ventrals. The belly is quite dark in northern specimens.

Of fourteen Panamanian specimens twenty-seven sides have two loreals; a single side has one. Ten Nicaraguan specimens show fifteen cases of two loreals, five of one loreal. All specimens from Honduras, Petén and Belize have a single loreal.

There are three instances of three preoculars against twenty-five of two preoculars in Panamá. Specimens from Nicaragua, Honduras, and Petén have regularly two preoculars. Specimens from Belize have three preoculars.

Thus in color and in head scutellation the population of Panamá is quite different from that of Belize. In color the Nicaraguan and Honduranian specimens, while nearer the Panamá type, show a tendency for row one to be darker and for row three to be lighter, thus approaching the Petén-Belize type. The loreal change takes place between Nicaragua and Honduras. The preocular alteration seems practically confined to Belize. I have divided the races, for the purpose of allocating specimens, by color.

Tretanorhinus nigroluteus nigroluteus Cope

Tretanorhinus nigroluteus Cope, Proc. Acad. Nat. Sci. Phila., 1861: 298; Günther, Ann. Mag. Nat. Hist., (4), 9, 1872: 27; Bocourt, Le Naturaliste, (2), 5, 1891: 122; Boulenger, Cat. Snakes Brit. Mus., 1, 1893: 283; Bocourt, Miss. Sci. Mex., Zool., 3, Sect. 1, 1893: pl. 54, fig. 1; *l.c.*, 1895: 798.

Helicops agassizii Jan, Arch. Zool. Anat. Phys., 3, 1865: 248 (San Juan del Norte, Nicaragua, MCZ 826, type); Icon. Ofid., 28, 1868: pl. 2, fig. 1.

Helicops bifrenatus Bocourt, Bull. Soc. Philom., (7), 8, 1884: 134 (Colon, Panamá, type in Paris).

Tretanorhinus intermedius Rosén, Ann. Mag. Nat. Hist. (7), 15, 1905: 171 (Central America, type in Lund).

TYPE.—USNM 5568, collected by Dr. Caldwell.

TYPE LOCALITY.—Aspinwall, Panamá. Erroneously given as Greytown, Nicaragua, in the original description.

RANGE.—Atlantic drainage of Panamá Canal Zone; Atlantic drainage of Nicaragua and Honduras.

Tretanorhinus nigroluteus lateralis Bocourt

Tretanorhinus lateralis Bocourt, Le Naturaliste, (2), 5, 1891: 122; Bocourt, Miss. Sci. Mex., Zool., Sect. 3, 1893: pl. 52, fig. 4; Bocourt, *t.c.*, 1895: 800.

Tretanorhinus nigroluteus Stuart, COPEIA, 1937: 69 (Petén).

TYPES.—Originally two in Paris. Not examined.

TYPE LOCALITY.—Belize.

RANGE.—Known only from Belize and Petén.

HABITS OF MAINLAND *Tretanorhinus*

These snakes are practically unknown ecologically. Hubbs says of *lateralis* in Petén (Stuart, 1937): "purely aquatic ophidian dives to the bottom when surprised and there seeks protection in the crevices of rocks, etc., from which no amount of confusion can disturb it. One of the specimens was caught in a gill net from which it had stolen a *Cichlasoma octofasciata* (Regan)."

Barbour and Amaral (1924), writing of *nigroluteus* and *moquardi* in the Canal Zone as of one species, say: "one of the very few that frequent salt water. It is found about mangrove swamps, if not exclusively, at least frequently, having much the habits of *Natrix compressicauda*."

I have had considerable experience with the form of the genus that occurs at Soledad, near Cienfuegos, Cuba. This is found abundantly in the water of small streams at night. Since a great deal of time spent around small

streams at night in the Canal Zone and elsewhere in Panamá has never once brought a specimen of *Tretanorhinus* under my observation, I infer that the mainland forms differ ecologically from their Cuban congeners.

Generic Characters and Relationships

Dorsal scales keeled, striate, pitless, reducing by dropping the paravertebrals, 21-17; subcaudals double; anal double; head scales normal with at times two loreals and at times one or three prefrontals; internasals small; pupil circular to slightly oval; maxillary teeth about 27, subequal; hemipenis single or slightly bilobed; calyculate area capitate; sulcus forks within the calyculate area; four basal hooks; between hooks and calyculate area about four cross rows (about ten longitudinal rows) of rather uniform smaller spines; posterior hypapophyses present, low.

The hemipenis is most like that of some of the forms of the *Rhadinaea-Coniophanes-Trimetopon* series. The dentition, the dorsal scales, and the hypapophyses are similar to those of *Ninia* (*Tretanorhinus* has more maxillary teeth). These similarities may be an indication of relationships. There is also a resemblance in hemipenis and hypapophyses to *Amastridium*, but *Amastridium* has only two basal hooks on the hemipenis, and is very different in dentition. In dentition and in hemipenis there is close similarity with the endemic central upland genus *Hydromorphus*.

Literature Cited

Amaral, Afranio do
1929 Estudos sobre ophidios neotropicos. XVII. Valor systematico de varias formas de ophidios neotropicos. *Mem. Inst. Butantan*, 4: 1-68.

Barbour, Thomas and Amaral, Afranio do
1924 Notes on some Central American snakes. *Occ. Pap. Boston Soc. Nat. Hist.*, 5: 129-132.

Bocourt, M[arie-Firmin]
1891-1895 Miss. Sci. Mex., Zool., 3, sec. 1, livr. 12-14: 697-830.

Jan, G[iorgio]
1863 Elenco sistematico degli ofidi descritti e disegnati per l'iconografia generale. A. Lombardi, Milano: VII+143 + [2].
1864 Prodromo della iconografia générale degli ofidi. VIII. Potamophilidae. *Arch. Zool. Anat. Fisiol., Genoa*, 3, fasc. 2: 201-265.
1868 Iconographie générale des ophidiens, Livr. 28. Milan: 6 pls.

Wood, G. Congdon
1939 The genus *Tretanorhinus* in Cuba and the Isle of Pines. *Proc. New Engl. Zool. Club*, 18: 5–11.

Haverford College, Haverford, Pennsylvania.

Carphophis amoena vermis and *Lampropeltis calligaster* in Iowa[1]

By Reeve M. Bailey

IN AN uncritical and anonymous list of the reptiles and amphibians of Fremont County, Iowa (1881: 361), there appear the bare notations "*Ophibolus calligaster,* Kennicott's Chain Snake"; "*Carphophiops amoenus,* ground snake"; and "*Carphophiops vermis,* worm snake, rare and local." Subsequently, Osborn (1892: 9) listed "*Ophibolus calligaster* (Say), (Call det.)" among the reptiles of Iowa. Somes (1911) included *Carphophiops amoenus* (p. 149) and *Ophibolus calligaster* (p. 150) in his list of the reptiles of Iowa. The above records are open to question since each of these catalogues includes species which are obviously incorrectly accredited to the Iowa herpetofauna, and because there are no descriptions, substantiating specimens, or evidence (with the exception of that of Osborn) that the lists are more than hypothetical enumerations selected from general accounts.

Blanchard (1925: 530) included southeastern Nebraska in the range of *Carphophis amoena vermis,* but made no mention of Iowa. Guthrie (1926: 190) listed *Carphophis amoena* (Say) as likely to occur in Iowa.

In the Iowa State College collection there is a specimen of *Carphophis amoena vermis* (Kennicott) collected at Keosauqua, Van Buren County, Iowa, on December 16, 1933, by Dr. Homer Hixon. The body is black dorsally, with the pinkish color of the belly extending up to the middle of the third row of dorsal scales. There are 4 plates anterior to the frontal, the prefrontals much larger than the internasals; upper labials 5–5; lower labials 6–6; temporals 1 + 1 on each side; ventrals 144 (2 higher than the maximum recorded by Blanchard); subcaudals 26; anal divided; total length 333 mm.; tail length 40 mm. (12.0% of total length); female.

In regard to *Lampropeltis calligaster* Blanchard (1921: 121) stated that "There is no record for Iowa or Nebraska . . . ," but he listed a specimen from "Minnesota." Dr. E. R. Dunn has kindly rechecked this specimen (Academy of Natural Sciences, Philadelphia, No. 16633; A. E. Brown, 1905). Since Brown was associated with the Philadelphia Zoological Garden the locality is possibly erroneous. Taylor (1892: 341–342) described specimens from Lancaster and Nemaha counties in southeastern Nebraska, under the name *Ophibolus triangulus,* var. *calligaster* Say. Guthrie (1926: 160) did not include *L. calligaster* among the snakes of Iowa since he had no reliable record.

It now appears that *Lampropeltis calligaster* (Harlan) not only occurs in Iowa, but that it is one of the commonest species of snakes in the southern part of the state; all of the seventeen localities from which specimens have been examined are in the three southern tiers of counties. Eight preserved specimens from six localities have been studied; the remaining records are based on examination of individuals killed on highways (DOR) and too badly decayed or crushed to warrant preservation. The records are as follows: Appanoose Co., highway 3, 5.4 miles east of Promise City, DOR, May 14, 1939; highway 3, 6 miles west of Centerville, DOR, May 14, 1939;

[1] Journal Paper No. J653 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 568.

highway 60, 1.8 miles north of Centerville, 4 specimens, DOR, May 14, 1939. CLARKE Co., U. S. Highway 69, 9 miles northeast of Osceola, 3 specimens, Iowa State College collection, April 23, 1939. FREMONT Co., south shore of Lake Waubonsie, 3 miles south-southeast of Bartlett, I.S.C., April 29, 1939. MAHASKA Co., Rose Hill, I.S.C., October 10, 1938, Dr. Harold Gunderson. RINGGOLD Co., U. S. Highway 169, 7.8 miles north of Mt. Ayr, DOR, May 13, 1939; U. S. Highway 169, 6.5 miles north of Mt. Ayr, 1 DOR and 1 in I.S.C. collection, May 13, 1939; U.S. Highway 169, 1 mile north of Mt. Ayr, 1 DOR and 1 dead in nearby field; highway 3, 1.5 miles west of Mt. Ayr, DOR, May 13, 1939; highway 3, 2.5 miles west of Mt. Ayr, DOR, May 13, 1939. TAYLOR Co., highway 3, 7 miles east of Bedford, DOR, May 13, 1939; highway 3, 4 miles east of Bedford, DOR, May 13, 1939. VAN BUREN Co., near Bentonsport, Carnegie Museum No. 9777,[2] Oct. 12, 1936, Paul L. Swanson. WARREN Co., U.S. Highway 69, 11 miles south of Indianola, DOR, in I.S.C. collection, April 23, 1939. WAYNE Co., highway 3, 4 miles west of Corydon, DOR, May 14, 1939; highway 3, 1.3 miles east of Corydon, DOR, May 14, 1939.

The three individuals taken in Clarke County were collected between 10 and 10:30 o'clock on the clear, warm (69° F.) evening of April 23, 1939. One was on the shoulder of the highway and the others were nearby, actively moving along the grassy roadside. Cultivated fields bordered the roadway on both sides. The Warren County specimen was found, freshly killed, at 11:05 P.M. the same evening. The spring of 1939 was unseasonably cold, except for a week of warm weather during late March. This was followed by three heavy snow storms, however, and the next period of warm weather began on April 22. It seems probable that these four specimens had recently emerged from winter quarters; the close proximity of three of them suggests gregarious hibernation. It is evident that they are at least partially nocturnal during the early spring. That they are not entirely so is indicated by the Fremont County specimen which was actively crawling along the edge of a wooded pasture at 4:30 in the afternoon while the sun was shining.

In color pattern and scutellation our specimens of *L. calligaster* agree well with Blanchard's description (1921: 117–120). Each has a single anal, smooth scales, and upper labials 7–7. In the Van Buren County individual the temporals number 2+4+5 and 2+3+5; in the others 2+3+4. One example from Clarke County has 10 lower labials on the left and 9 on the right side; the rest have 9 on both sides. Other characters of scutellation and pattern are given in the accompanying table.

County	Sex	Ventrals	Subcaudals	Body blotches	Tail blotches	Scale rows
Mahaska	♀	207	49	44	13	25–23–21–19
Ringgold	♀	205	45	47	16	25–23–21–19
Van Buren	♀	206	47	41	14	25–26–27–25–23–21
Clarke	♀	202	48	60	17	25–23–21–19
Clarke	♀	206	48	42	14	23–25–27–25–23–21
Clarke	♂	210	50	45	15	25–23–21
Warren	♂	204	51	55	19	25–27–25–23–21
Fremont	♂	201	53	54	18	25–23–25–23–21

[2] Examined through the kindness of Mr. M. Graham Netting.

LITERATURE CITED

ANONYMOUS
1881 History of Fremont County, Iowa. Des Moines, Iowa Historical Company: i-viii; 1-778. (Reptilia, 360-363.)

BLANCHARD, FRANK N.
1921 A Revision of the King Snakes: Genus Lampropeltis. *U. S. Nat. Mus., Bull.* 114: i-vi, 1-260, text figs. 1-78.
1925 The forms of Carphophis. *Pap. Mich. Acad. Sci. Arts and Letters,* 4: 527-530.

GUTHRIE, J. E.
1926 The snakes of Iowa. *Agr. Exp. Sta., Iowa State Coll. Agr. and Mech. Arts, Bull.* 239: 146-192, figs. 1-21.

OSBORN, HERBERT
1892 A partial catalogue of the animals of Iowa. *Iowa Agr. Coll.*: 1–39.

SOMES, M. P.
1911 Notes on some Iowa reptiles. *Proc. Iowa Acad. Sci.,* 18: 149–154.

TAYLOR, W. EDGAR
1892 The Ophidia of Nebraska. *Ann. Rept. Nebraska State Bd. Agr. for 1891*: 310-357.

DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY, IOWA STATE COLLEGE, AMES, IOWA.

Correct Terminology in Salamander Myology

I. Intrinsic Gill Musculature

By JEAN PIATT

THE student of comparative anatomy and embryology is continually confronted with the problem of correct terminology for the structures with which he must deal. It is difficult for any one person to acquire sufficient first hand information of the related forms in his field, so that he must depend largely on the work of others for the proper allocation of names and terms. This difficulty is partially obviated in the Caudata, since the group is sufficiently small and homogeneous to make possible an adequate survey of the entire order. Notwithstanding this fact, there still exist in the literature on the head muscles of salamanders misinterpretations in the terminology that are as needless as they are confusing.

I have examined thoroughly representatives from all the families of the Caudata with respect to the striated cranial musculature. In the families Proteidae, Necturidae, Amphiumidae, Cryptobranchidae, Sirenidae, Ambystomidae, and Plethodontidae, at least one species has been examined in every genus. In the two remaining families, Hynobiidae and Salamandridae, I have

examined species from the genera *Hynobius, Pleurodeles, Salamandra,* and *Triturus.* Many of these were examined in serial section also. In addition, a recent investigation (Piatt, 1938) of the complete embryological development of the striated cranial musculature in *Ambystoma maculatum* has been made, and the results compared with the development of other forms whenever it was possible. It is on the basis of this information and a thorough study of the literature that I venture to suggest the corrections set forth below. The titles which appear at the end are only a very small fraction of the papers consulted.

Concerning the terminology of the head muscles of salamanders there are at present only two groups of muscles which are badly in need of clarification. These are the gill musculature and the superficial transverse ventral throat musculature. The first of these groups will be considered in this paper.

Gill Musculature

Direct electrical stimulation of the levatores branchiarum in *Ambystoma maculatum* (Piatt, 1938) has shown that this set of muscles functions more as adductors of the gills than as levators. From this one fact alone, then, it would seem preferable to call the muscle running dorsal to the efferent branchial artery in the gill the adductor branchii instead of the levator branchii. Following the nomenclature of Fischer (1864) several investigators have done this and referred to some or all of the levatores branchiarum as the adductores branchiarum. The confusion resulting from this indiscriminate use of the two terms "levatores" and "adductores" for one set of gill muscles is complicated further by the presence in Caudata of another muscle, the omo-arcualis. This latter muscle has frequently been called the adductor branchii 3.

Mivart (1869: 459) has employed all three terms in his description of the gill muscles of *Necturus:* "levatores," "depressores," and "adductores" branchiarum. Apparently he has described three adductores branchiarum in addition to the levatores and depressores, but his figures show only the most posterior, a muscle running obliquely upward from the shoulder girdle to the third epibranchial. This muscle is the omo-arcualis.

Platt (1897: 442) also recognized three sets of gill tuft muscles in *Necturus.* It is impossible, however, from her account to know how she distributes the three names among the muscles in question.

Wilder (1891: 668) has referred to the anterior two dorsal gill muscles in *Siren* as the adductores branchiarum and the third as the levator branchii, and has recognized three depressores branchiarum. He describes and figures also the omo-arcualis, which he has called the procoraco-branchialis.

Coghill (1902: 239) speaks of adductores, levatores, and depressores in *Ambystoma tigrinum.* He mentions specifically the first and third levatores and the first, second, and third depressores branchiarum. The term adductor branchii he mentions only once, and that as the adductor of the first external gill. Since Coghill does not mention the levator branchii 2, and since this latter muscle serves in part as an adductor of the first gill, the only assumption possible is that Coghill has called the levator branchii 2 the adductor branchii 1.

Edgeworth (1922: 104) describes an omo-arcualis in the larva of *Hynobius* in addition to the levatores and depressores branchiarum. This muscle persists in the adult. Edgeworth (1935: 161) also states that this muscle is present in *Proteus*.

Eaton (1936: 70) tacitly assumes that the omo-arcualis occurs only in *Siren*. Following Wilder (1891), he calls it the procoraco-branchialis. Eaton suggests that the omo-arcualis may be homologous with part of the interhyoideus posterior (gularis of Eaton) of *Amphiuma*.

The depressores branchiarum have suffered no confusion in the literature and may be dismissed from further discussion.

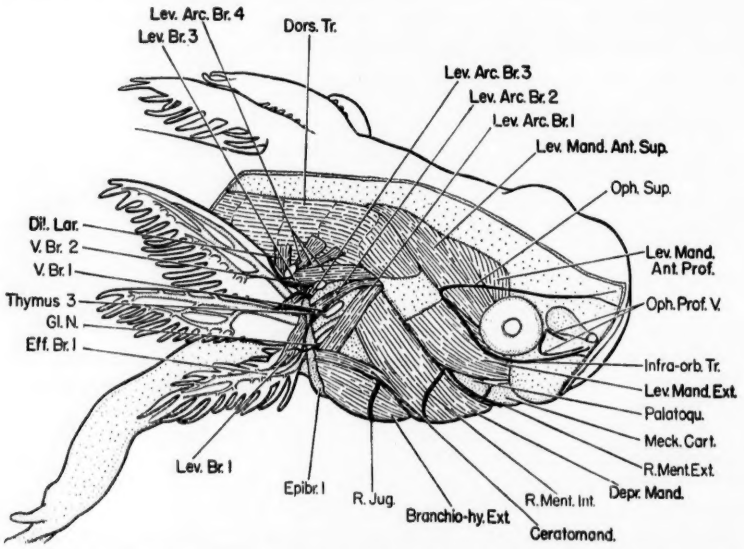

Fig. 1. Dissection of full grown larva of *Ambystoma maculatum* to show muscles, nerves, and accompanying structures of head. Dorso-lateral view of right side. X4.

The embryological development, innervation, and arrangement of the dorsal gill tuft muscles in the Caudata point to the indisputable fact that they are in a strict sense serially homologous with each other. These muscles should be known by only one name, either levatores branchiarum or adductores branchiarum, but never by both. I suggest the name *levatores branchiarum* as the preferred allocation, since this term has gained a more general usage among workers. In the Proteidae, Necturidae, Hynobiidae, and Sirenidae there is an additional muscle connected with the gills—the omo-arcualis. This muscle, as pointed out above, has sometimes been referred to as the adductor branchii 3. It would make for clarity of nomenclature if this latter term were dropped and the name *omo-arcualis* used for this muscle, since if called an adductor branchii it might be misconstrued as implying serial homology with the dorsal gill tuft muscles (levatores branchiarum). The omo-

arcualis arises from the ventral mesoderm of the third or fourth branchial arch in ontogeny. As suggested by Eaton (1936) the omo-arcualis may be homologous with the interhyoideus posterior, although Eaton does not imply their serial homology. In view of the embryological origin of the interhyoideus posterior from the ventral mesoderm of the hyoid arch, these two muscles could conceivably be serially homologous with each other but it would be impossible for one to be the homologue of the other, since they both occur in the same individual.

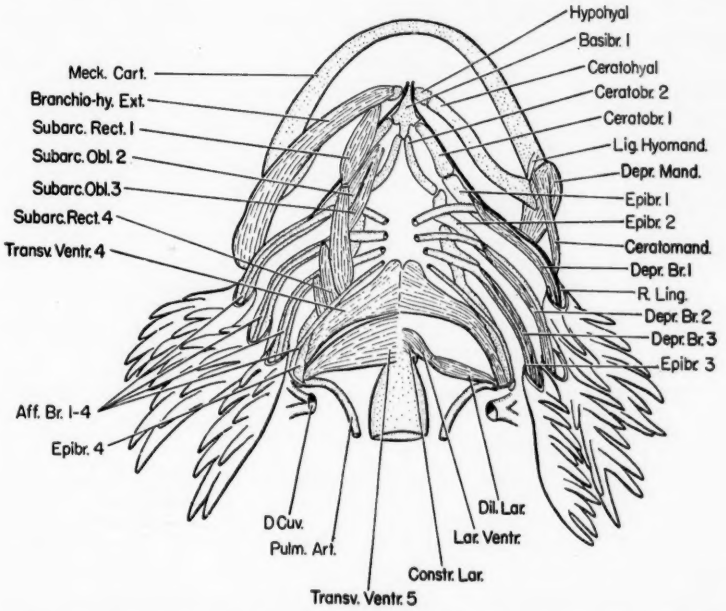

Fig. 2. Dissection of full grown larva of *Ambystoma maculatum* to show deep muscles and accompanying structures of head. Ventral view. The more superficial transverse and longitudinal muscles have been removed. X4.

Aff. Br. 1–4, afferent branchial artery 1–4
Basibr. 1, basibranchial 1
Branchio-hy. ext., M. branchio-hyoideus externus
Ceratobr. 1–2, ceratobranchials 1–2
Ceratohyal, ceratohyal
Ceratomand., M. ceratomandibularis
Constr. Lar., M. constrictor laryngeus
D. Cuv., duct of Cuvier
Depr. Br. 1–3, Mm. depressores branchiarum 1–3
Depr. Mand., M. depressor mandibulae
Dil. Lar., M. dilatator laryngeus
Dors. Tr., M. dorsalis trunci
Eff. Br. 1, efferent branchial artery
Epibr. 1–4, epibranchials 1–4
Gl. N., N. glossopharyngeus
Hypohyal, hypohyal
Infra-orb. Tr., N. truncus infra-orbitalis
Lar. Ventr., M. laryngeus ventralis
Lev. Arc. Br. 1–4, Mm. levatores arcuum branchiarum 1–4
Lev. Br. 1–3, Mm. levatores branchiarum 1–3
Lev. Mand. ant. prof., M. levator mandibulae anterior profundus
Lev. Mand. ant. sup., M. levator mandibulae anterior superficialis
Lev. Mand. Ext., M. levator mandibulae externus
Lig. Hyomand., hyomandibular ligament
Meck. Cart., Meckel's cartilage
Oph. Prof. V., N. ophthalmicus profundus V.
Oph. Sup., N. ophthalmicus superficialis VII
Palatogu., palatoquadrate
Pulm. Art., pulmonary artery
R. Jug., N. ramus jugularis VII
R. Ling., N. ramus lingualis IX
R. Ment. Ext., N. ramus mentalis externus VII
R. Ment. Int., N. ramus mentalis internus VII
Subarc. Obl. 2–3, Mm. subarcuales obliqui 2–3
Subarc. Rect. 1, 4, Mm. subarcuales recti 1 and 4
Thymus 3, Thymus
Transv. Ventr. 4–5, Mm. transversi ventrales 4–5
V. Br. 1–2, N. truncus branchialis vagi 1–2

The levatores branchiarum and depressores branchiarum occur in all salamanders during the gill bearing period, and constitute the intrinsic gill musculature. The omo-arcualis is found only in the Proteidae, Necturidae, Hynobiidae, and Sirenidae and is not serially homologous with either of the two sets of intrinsic gill muscles. The term adductores branchiarum has no place in urodele myology.

Summary

1. The intrinsic gill musculature of the Caudata is discussed, with regard to a revision of nomenclature.

2. In all salamanders there are only two sets of intrinsic gill muscles. The dorsal set should be called the *levatores branchiarum,* and the ventral set the *depressores branchiarum.* In the Proteidae, Necturidae, Hynobiidae, and Sirenidae a third gill muscle appears, connecting the terminal portion of the most posterior gill bar to the procoracoid cartilage. This muscle should be known as the *omo-arcualis.*

Literature Cited

Coghill, G. E.
1902 The cranial nerves of *Amblystoma tigrinum. Jour. Comp. Neurol.,* 12: 205-289.

Eaton, T. H., Jr.
1936 The myology of salamanders with particular reference to *Dicamptodon ensatus* (Eschscholtz). I. Muscles of the head. *Jour. Morph.,* 60: 31-75.

Edgeworth, F. H.
1922 On the larval hyobranchial skeleton and musculature of *Cryptobranchus, Menopoma, Ellipsoglossa. Jour. Anat.,* 57: 97-105.
1935 The cranial muscles of vertebrates. Cambridge: 1-493.

Fischer, J. G.
1864 Anatomische Abhandlung über die Perennibranchiaten und Derotremen. Hamburg.

Mivart, St. G.
1869 Notes on the myology of *Menobranchus lateralis. Proc. Zool. Soc. London,* 1869: 450-466.

Piatt, Jean
1938 Morphogenesis of the cranial muscles of *Amblystoma punctatum. Jour. Morph.,* 63: 531-587.

Platt, J. B.
1897 The development of the cartilaginous skull and of the branchial and hypoglossal musculature in *Necturus. Morph. Jahrb,* 25: 377-464.

Wilder, H. H.
1891 A contribution to the anatomy of *Siren lacertina. Zool. Jahrb.* (*Anat.*), 4: 653-696.

Department of Anatomy, University of Vermont, Burlington, Vermont.

Field Notes on *Hyla wrightorum* Taylor

By William L. Chapel

WHEN the author left Ithaca, New York, in June, 1933, to join the U. S. Forest Service in Arizona, Dr. A. H. Wright asked him to be on the lookout for any specimens of the Sonora tree frog, at that time recognized as *Hyla eximia* Baird. More recently Taylor (1938: 436–9, Pl. XLVII, fig. 1) has redescribed this frog, proposing for it the new name *Hyla wrightorum*. Data on this species have been collected during the past five seasons. During the first four of these, the author's connection with the Civilian Conservation Corps provided many willing collectors.

Range in Arizona.—To date the author has found this frog only on the southern forested edge of the Colorado Plateau from the vicinity of Williams east to McNary. The full range extends east to Texas and south into Mexico.

The Colorado Plateau extends roughly east and west through central Arizona into New Mexico. The altitude is approximately 7,000 feet above sea level. In general the southern part is in the transition zone and is covered by typical vegetation including a broad belt of ponderosa pine with small areas of Douglas fir, white fir, Mexican white pine, and other trees. The pines are predominant in a mixture including species of oaks, junipers, and piñon pine; the particular admixture depending on local conditions. The frogs have been found throughout the forest.

No specimens of *Hyla wrightorum* were found in the isolated Pinal Mountains, south of Globe, although they reach from upper Sonoran through the transition zones, ranging from 4,000 to 8,000 feet in elevation.

No frogs were found in the large springs at Pinetop, whose waters have a temperature of about 50°F. The waters of open ponds are warmed during the day, and remain at a higher temperature.

The lower limit of the distribution of the species in this region seems to be defined by the rim of the Colorado Plateau, with an elevation of 5,000 feet. The 1936 season was spent at Indian Gardens, 22 miles east of Payson, in an area directly beneath the rim of the plateau (here called the Mogollon or Tonto Rim). No specimens were found in this well forested area, though frogs were found on the plateau above on several trips.

Hyla eximia was not listed for the Grand Canyon National Park (McKee and Bogert, 1934).

Judging from the small number of specimens found, Williams is probably the western edge of this frog's range. Although the summer rains were few in 1937, they were heavy enough to have brought out all individuals, but very few were found. Many suitable ponds were completely barren. Continuing east, numerous specimens were found along the rim. At Hart Canyon, which is 50 miles south of Winslow, and at Pinetop and McNary the numbers in the summer ponds were very great.

Habitat.—Before and after the breeding season the frogs are found occasionally throughout the forest. Clever camouflage and ventriloquism aid them in escaping detection. They are found on the ground in damp places and in the trees. Twice the author found several which had been jarred loose when a tree was felled. In one of these instances, a frog fell from the

top of a tree about 75 feet high. On sultry days they were heard calling from the trees.

SIZE.—The body length varies from 25 mm. to 48 mm. Some only 20 mm. long have been seen in a chorus, but never actually in copulation.

ASSOCIATED SPECIES.—The species associated with *Hyla wrightorum* (though also found where it does not occur) are *Bufo cognatus, Bufo compactilis, Pseudacris n. triseriata,* and *Rana pipiens. Hyla arenicolor* was found with the *Pseudacris* at both Indian Gardens and in the Sierra Anchas north of Roosevelt Lake, but not as yet on the Colorado Plateau.

BREEDING SITES.—The migration of frogs toward fresh rain-water pools begins as soon as the summer rains start. As a result, during the breeding season, they are found by permanent lakes (but seldom before the rains), new ponds, brooks, and all places where the rain-water collects in sufficient quantities. In fact, several specimens were found in wells 20 feet deep. The numbers of specimens present indicate that large, grassy, shallow ponds are favored when available. These large shallow ponds are quite common in the typical open parks in the ponderosa pine forests in central Arizona. The grass provides resting places for the frogs. In open water a few may swim about, but the majority remain along the edge, resting on the bottom.

BREEDING SEASON.—The breeding season is from June to August, but in any year the dates vary. The determining factor is the heavy summer rains common on the Colorado Plateau in July and August. These storms delimit the breeding season. The seasons noted were:

1933 Pinetop and Hart Canyon	7,000 feet	July 2—Aug. 9.....	heavy rains
1935 Pinetop	7,000 feet	July 7—July 28.....	normal rains
1937 Williams	7,000 feet	July 2—July 14.....	subnormal rains

Breeding is intermittent within this period. Fresh rains bring out a renewed chorus. A chorus usually lasts two or three nights and then quickly thins out to a few disconsolate males for two to four more nights. A chorus continues all night, with the greatest volume before midnight. Probably new individuals make up most of each new chorus.

EGG AND TADPOLES.—The duration of the egg and tadpole stages is unknown. Some eggs were tagged near Pinetop, but the author was transferred the next day. No eggs have been found elsewhere. Some tadpoles were corralled several times, but subsequent freshets removed the broods.

Many choruses and many tadpoles have been found in rapidly flowing brooks, but no eggs have been found. Probably the egg masses either are laid in quiet back-washes or are washed into them to hatch. The frequent freshets cause high mortality, and after the rainy season as the brooks dry up many tadpoles are isolated in pools and are dried up with the water.

Frequently in small pools the water is nearly black with the swimming tadpoles. The tadpoles gather in very shallow, warm side-pools full of decaying vegetable matter. They also gather in great numbers around fresh cow manure and apparently feed on the dissolved and softened material. In areas where this species is abundant, in late summer, when the tadpoles transform, the ground around the ponds is covered with the out-going froglets. These vary in length from 10 to 13 mm. Many leave the water still carrying stubby tails.

FOOD.—The stomachs of seven specimens taken in 1937 near Williams included the following food: 7 beetles, 1 spider, 2 small earthworms, 1 fly, grass particles, and four specimens of *Ips*. The four *Ips* are of special interest. Since three of seven individuals had been feeding on this forest insect pest, it is not improbable that *Hyla wrightorum* may be of some importance in helping to control it. The author plans to make a special study of this problem.

LITERATURE CITED

McKEE, EDWIN, and CHARLES M. BOGERT
1934 The amphibians and reptiles of Grand Canyon National Park. COPEIA, 1934: 178–180.

TAYLOR, E. H.
1938 Frogs of the *Hyla eximia* group in Mexico, with descriptions of two new species. *Univ. Kansas Sci. Bull.*, 25 (19): 421–445.

WRIGHT, A. A., and A. H. WRIGHT
1933 Handbook of frogs and toads. Ithaca, New York: xi + 231.

U. S. FOREST SERVICE, WILLIAMS, ARIZONA.

Frequency of Skin Shedding in Snakes

By ROBERT M. STABLER

DESPITE the fact that countless snakes have been observed in zoological gardens and private collections the world over, relatively few data have been published on the phenomenon of skin shedding in these reptiles. Carr (1926) and Leigh (1928) record observations on a copperhead (*Agkistrodon mokasen*) and a python (*Python molurus*) respectively. The most extensive account is a review by Ahl (1930); reporting mainly the observations on shedding by Werner in Brehm's *Tierleben*, he gives information on numerous vipers, pythons and colubrine snakes. The writer has collected data on this topic from the snakes in his own collection. He would like to express his appreciation to Roger Conant of the Philadelphia Zoological Garden for valuable suggestions concerning the manuscript.

It must first be emphasized that the data included here are exclusively from snakes that fed readily and were to all external appearances perfectly healthy. It should also be stated that they were kept in a room which was not specially heated, and as a result the winter temperatures sometimes went as low as 40°F. This resulted in a state of pseudo-hibernation which has been called the "rest period." During this time the snakes sometimes lay motionless for days, took food sparingly and shed rarely. This period, usually commencing about October and extending to April, averaged 6.4 months in length. It was observed that the snakes continued to feed on the average only 0.8 months after their last fall shedding and commenced to feed in the spring 2.5 months before the first vernal moult.

Of the many snakes observed by the writer over a period of years, for various reasons only twenty-one were included, all of which (except *Elaphe guttata* No. 2, 11 months) had survived in captivity for a year or more. Table I shows the average duration of observations per reptile to have been a little under two years. It is seen that for all twenty-one serpents, on a total observation basis, there averaged a shedding once every 3.2 months. When the winter rest is counted out, however, the snakes averaged a shedding each 1.5 months.

TABLE I

Species	Number of Months Observed	Rest Periods (Months)	Number of Sheddings Observed	Average Number of Months Between Shedding: Basis Total Months Observed	Average Number of Months Between Shedding: Basis Rest Period Omitted
Elaphe guttata (1)	21	5, 7	6	3.5	1.5
Elaphe guttata (2)	11	7	4	2.8	1.0
Elaphe guttata (3)	22	4, 6	10	2.2	1.2
Elaphe q. quadrivittata (1)	36	10, 7, 5	10	3.6	1.4
Elaphe q. quadrivittata (2)	24	11, 7	5	4.8	1.2
Elaphe o. obsoleta (1)	13	6	6	2.2	1.2
Elaphe o. obsoleta (2)	35	7, 8, 7	7	5.0	1.8
Elaphe o. obsoleta (3)	12	7	2	6.0	2.5
Thamnophis s. sirtalis	33	7, 7, 8	8	4.1	1.4
Agkistrodon mokasen cupreus	24	6, 4	8	3.0	1.8
Agkistrodon piscivorus (1)	47	9, 6, 5, 8	15	3.1	1.3
Agkistrodon piscivorus (2)	12	5	3	4.0	2.3
Lampropeltis getulus holbrooki	32	7, 7	13	2.5	1.4
Lampropeltis g. getulus	12	5	5	2.4	1.4
Lampropeltis getulus californiae	12	5	4	3.0	1.8
Pituophis m. melanoleucus	12	7	2	6.0	2.5
Pituophis melanoleucus mugitus	12	7	5	2.4	1.0
Natrix s. sipedon (1)	15	2	7	2.1	1.9
Natrix s. sipedon (2)	15	5	7	2.1	1.4
Drymarchon corais couperi	19	3	6	3.2	2.0
Natrix natrix ssp.	12	6	2	6.0	3.0
Averages	20.5	6.4	6.4	3.2	1.5

Three snakes in Table I deserve special mention. The *Agkistrodon mokasen,* caught by me in New York State, refused all food for the first twelve months of captivity (not kept by me for this year; no shedding data), then suddenly commenced to eat willingly and survived two more years, dying as a result of having eaten a frog from a pond treated for mosquitoes. *Elaphe guttata* No. 1 and *Elaphe obsoleta* No. 1 were each in captivity approximately five years, though unfortunately, accurate data were kept only on the last 33 and 25 months respectively. It is of special interest that for the first year of data these two snakes were kept in a warm room with no interruption of normal activity. They averaged a shedding once every 1.5 (*E. guttata*) and 1.7 (*E. obsoleta*) months for this twelve month period. When removed to the unheated quarters, the rest period was introduced, and the shedding frequency dropped to once every 3.5 and 2.2 months respectively for the remaining twenty-one and thirteen months of their lives.

In previous reports on skin shedding, no point is made of the temperature conditions of the reptiles' quarters. It may be inferred, however, that the animals are mainly zoological park specimens, which would be kept at a fairly even temperature for all seasons. Table II summarizes certain of these data.

TABLE II

Investigator	Species	Number of Months Observed	Number of Sheddings Observed	Average Number of Months Between Sheddings
Carr (1926)	*Ancistrodon contortrix**	11	6	1.8
Leigh (1928)	*Python molurus*	16	9	1.8
Ahl (1930)	*Python bivittatus*	12	4	3.0
	Tropidonotus viperinus	12	4	3.0
	Coronella doliata	11	8	1.4
	Leptodira albofusca	18	13	1.4
	Psammophis sibilans	17	8	2.1
	Oxybelis acuminatus	12	4	3.0
	Bitis gabonica	12	1	12.0
	Ancistrodon contortrix	12	2	6.0
	Lachesis muta	12	1	12.0
	Crotalus adamanteus	12	2	6.0
	Crotalus adamanteus	12	4	3.0
	Sistrurus catenatus	12	2	6.0
	Averages	12.9	4.9	2.7

* —specific names are those used by the authors cited.

In conclusion it may be stated that during the non-rest periods there is a fair degree of uniformity in the time which elapses between moults, irrespective of the species of snake. Also, whereas no suggestion is offered as to the cause of ecdysis, the temperature of the environment through its effect on the rate of general functional activity seems indirectly to influence the frequency of shedding. Food is apparently not an important factor, as Carr's copperhead shed six times in eleven months, though refusing to eat.

LITERATURE CITED

AHL, ERNST
1930 Reptilia (Kriechtiere). *Tab. Biol.*, 6 (Suppl. 2): 625-715.

CARR, W. H.
1926 The fasting of a copperhead. COPEIA, 150: 104.

LEIGH, C.
1928 Notes on the Indian python (*Python molurus*) in captivity. *Jour. Bombay Nat. Hist. Soc.*, 33: 208-210.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PENNSYLVANIA.

HERPETOLOGICAL NOTES

PARTURITION IN THE TIMBER RATTLESNAKE, *CROTALUS HORRIDUS HORRIDUS* LINNÉ.—On August 20, 1933, near Catfish Pond, Warren County, New Jersey, Mr. Robert I. Ullman and the writer collected a 4-foot female timber rattlesnake heavy with young. She was kept in captivity until shortly after she gave birth to ten young on September 8. Since observations on parturition have apparently never been recorded for *Crotalus h. horridus*, as well as many other common species, the following summary seems worthy of note.

Three young were born between 10 and 11 A.M., while the cage was not under observation. At 11 A.M. one was completely free of the foetal membranes, a second had about one-third of its body free, and the third had its head alone out of the membranes.

12:25 A.M. The fourth snake visible at the anus. It was coiled within the foetal membranes, the middle part of its body being the first to appear.

12:28. The third snake had cleared itself of its enclosing membranes. The first snake extruded now moved about the cage.

11:32. The fourth snake completely extruded by the mother.

11:42. The fourth snake made its first movements in attempting to break through its foetal membranes. The snake was in a coil of two loops, with the head resting on the uppermost. Although perfectly motionless until this moment it now started a series of repeated efforts to break through its enclosing membranes by forcing the head upward, but did not succeed until thirty-nine minutes later.

12:23 P.M. The fifth snake extruded, and clear of the membranes.

12:31. The sixth snake appeared at the anus, doubled like the others. This snake was completely extruded six minutes later. A minute afterward it broke through the membranes.

12:55. Thirty minutes after emerging from its foetal membranes, the fourth snake was the first of the litter to make regular progressive movements.

1:08. The seventh snake appeared at the anus. Five minutes later it was completely extruded. In one more minute it broke through its membranes.

1:30. The eighth snake appeared at the anus and was completely extruded twenty-five minutes later, with its foetal membranes broken.

2:05. The ninth snake appeared. It was completely extruded, with its foetal membranes broken in twelve minutes.

A tenth snake appeared during the next half hour at a time when the writer was obliged to leave the cage unobserved.

On the first day after birth the umbilical stalk of the young dried and broke off. The mother and all but two of the young were disposed of shortly thereafter. Of the two young retained, one shed for the first time on September 25, the other on September 27.

Summary

1. Ten young were produced by a 4 foot *Crotalus h. horridus* over a period of approximately four and one-half hours during the middle of the day.

2. The intervals at which the young were extruded from the mother varied from eleven minutes to a little less than an hour.

3. The period from the first appearance of the young at the anus to the time of complete extrusion varied from five to twenty-five minutes.

4. The time from the extrusion of the young to the rupturing of the foetal membranes may be as long as forty-three minutes, or the membrane may be ruptured at or just before the actual parturition.

5. The coiled young ruptured the foetal membranes by a series of upward thrusts of the snout.

6. The umbilical stalk dried up, and broke off a day after birth.

7. The young snakes shed for the first time about eighteen days after birth.

Harold Trapido, *Zoological Laboratory, Cornell University, Ithaca, New York.*

NOTES ON *PSEUDOTRITON RUBER VIOSCAI* BISHOP.—Although more than ten years have passed since Dr. Bishop first described *Pseudotriton ruber vioscai* (1928, Occ. Pap. Boston Soc. Nat. Hist., 5: 247) very little information has accumulated concerning the distribution and variation of this subspecies.

I have at hand four specimens of this race from western Florida. Two of these were loaned to me by Mr. M. Graham Netting of the Carnegie Museum (C. M. nos. 11,000 and 11,001) and are from Marianna, Jackson County. One of the other specimens (U. F. 164) is from Kilby Creek, near Quincy, Gadsden County, and the remaining specimen (U. F. 46) was taken from the Torreya Ravines of Liberty County. I do not know in what situation the Jackson County individuals were found but the Torreya Ravines are deep, cool ravines which dissect the region around the Apalachicola River. Kilby Creek is similar to these ravines but not so deep. *Plethodon glutinosus* and *Eurycea l. gutto-lineata* are fairly common in these ravines and it was with these two species that Viosca found *vioscai* associated in Louisiana.

Measurements of these specimens are as follows:

Total length in mm.	Tail length in mm.	Percentage of tail in total length
137	54	39.3
99	40	40.4
133	50	37.5
147	53	36

Three of these have fifteen costal grooves and one has sixteen. They differ from *ruber* from South Carolina, North Carolina, and West Virginia which I have at hand in having a much darker dorsal ground color, most of the dorsal spots discernible, and in having the venter and under side of the tail covered with dots. The ventral spots are not concentrated on the midline. Two of the specimens have dorsal patterns similar to the one shown by Bishop in fig. 3, plate 15, and two have spots somewhat smaller but still perceptible. The ventral spots are smaller and closer together than those on the dorsum in all four specimens. There is a faint semblance of a herringbone pattern on two of the individuals. I cannot tell that the dentition differs from that of typical *ruber*.

This is, I believe, the first time this race has been recorded from Florida.—COLEMAN J. GOIN, *Department of Biology, University of Florida, Gainesville, Florida.*

SOME WEST INDIAN SNAKES OF THE GENUS *ALSOPHIS*.—The fact that some West Indian snakes are rare or extinct has been emphasized by Barbour (1930, Proc. New Engl. Zool. Club, 11: 73–85). As one of the species of *Alsophis* represented in the Field Museum's West Indian collections, *Alsophis leucomelas leucomelas* from Guadeloupe, is reported as extinct by Barbour in his most recent list of the West Indian herpetological fauna (1937, Bull. Mus. Comp. Zool., 82: 156), it seems desirable to record the specimens with their scale counts. I have added the scale counts of other West Indian species of the same genus in the collection. I am indebted to Mr. Karl P. Schmidt for the opportunity to examine this material.

Mus. Number	Locality	Sex	Dorsal Scales	Ventral Scales	Caudal Scales	Supralabials	Infralabials	Oculars	Temporals	Total Length	Tail Length
Alsophis leucomelas leucomelas											
256	Guadeloupe	♂	19–17–15	201	73	8	10	2/2	½	857	tail broken
254	Guadeloupe	♂	19–17–15	204	138	8	10	2/2	½	900	333
Alsophis caymanus											
258	Grand Cayman	♀	17–15–13	178	124	8	10	½	½	723	230
257	Grand Cayman	♂	17–15–13	172	128	8/7	10	½	½	1028	336
Alsophis vudii vudii											
27857	Long Id., Bahamas	♂	17–15–15	168	122	8	10	½	½	800	256
23618	New Providence "	♂	17–15–13	162	116	8	10	½	½	658	252
23619	Eleuthera Id., "	♀	17–15–15	169	...	8	10	½	1/3	858	tail broken

ROBERT A. BURTON, *Evanston, Illinois.*

A GECKONID LIZARD NEW TO THE FAUNA OF THE UNITED STATES.—In view of the extensive herpetological ransacking to which Key West has been subjected during recent years, the discovery there of a populous and apparently well established colony of an unsuspected lizard is astonishing.

I have a vague recollection that some Cuban boys who helped me catch geckos in Key West six years ago had something to say about black lizards with yellow heads. Our collection turned up no such creature, however, and I dismissed the reports as merely an attempt to entertain me. In a recent conversation with Mr. Roy S. Humbert of Philadelphia, who for many years has collected and kept live lizards as a hobby, the subject of yellow-headed lizards was again introduced. When Mr. Humbert invited me to come and see a collection of Key West lizards which, he said, included a yellow-headed form that he seemed to recall having seen in Central America years ago, I was naturally greatly interested. The box which he showed me contained several specimens each of *Anolis carolinensis, A. stejnegeri, Hemidactylus turcicus, Sphaerodactylus notatus,* and *S. cinereus,* and in addition, eighteen specimens—of all ages—of a sexually dimorphic gecko which I had never seen before, and which I subsequently decided must be *Gonatodes fuscus* (Hallowell). Dr. Thomas Barbour has kindly corroborated this identification. This lizard has hitherto been known from Cuba and Central America. Barbour (1922, Handbook of Jamaica: 2) makes the following remarks regarding it: "This is the little lizard without eyelids and with no toe-pads or digital dilations. It is common in Cuba, especially about the larger seaports, and may have been introduced into Cuba long ago. . . . It is generally a house lizard, and is peculiar in that the males are dark slate colour with yellowish head marked with sky blue, while the female is 'pepper and salt' colour or mottled."

Mr. Humbert's account of the discovery sheds little light on the question of why the lizard has not been found in Key West before. His specimens were taken April 23, 1939, between 1 and 3 P.M., after three days of heavy rains. They were all collected about the buildings and platforms of the old railroad docks on the western side of the island, where they must have been really very common, since besides the eighteen specimens taken by Mr. Humbert and two helpers numerous others were observed running about on the walls and platforms. Several individuals were seen feeding on spiders.

Undoubtedly introduced by commerce, and perhaps confined to the immediate vicinity of the old freight docks, these lizards have quite likely been in Key West for many years. Their seeming abundance, and the presence of many young in the area indicate strongly that they have become a permanent addition to the Florida fauna.

Two of the three specimens with which Mr. Humbert presented me have been sent to the Museum of Comparative Zoology; the third is in the collection of the Department of Biology, University of Florida.—A. F. CARR, JR., *Department of Biology, University of Florida, Gainesville, Florida.*

A WINTER AGGREGATION OF *SIREN INTERMEDIA* AND *TRITURUS VIRIDESCENS*.[1]—An aggregation of *Siren intermedia* Le Conte and *Triturus viridescens* Rafinesque was observed in a cement culvert one mile northeast of Herrin, Illinois, January 1, 1939, by Messrs. Jack Henderson and Philipp E. Smith. The culvert, which is 6 feet high, 5 feet 9 inches wide, and 40 feet long, connects two ponds otherwise separated by a railroad embankment. One pond is formed from the backwaters of a railroad reservoir and the other was caused by a slight settling of the land about twenty-five years ago. Both have a maximum depth of 4 feet and are practically covered with a dense growth of aquatic vegetation. The ponds were covered with a half inch layer of ice, but the shallow pool of water (about 7 inches deep) within the culvert was not frozen. The bottom within the culvert was composed of a coarse 3-inch layer of cinders covered with a thin layer of fine mud.

On January 1 one hundred *Siren* and twenty-one *Triturus* were collected in this pool in two hours. The newts were resting on the bottom between a railroad tie, a large cinder, and the culvert wall. The *Siren* were in the same area, but were buried in the cinder layer or were lying under the railroad tie and cinder. They were comparatively inactive and easily secured. Several tadpoles of *Rana catesbeiana* and one small *Sternotherus odoratus*

[1] Contribution from Museum of Natural and Social Sciences, Southern Illinois Normal University.

were also collected. Twenty-nine sirens that had been killed by school boys and thrown on the ice were taken in to be examined.

On the next day, January 2, the air temperature was 7°C and the water temperature 1.5°C; the weather conditions were very similar to those of the previous day, nine more *Siren* and nine more newts were collected, making a total of 138 *Siren* and thirty newts from the situation described.

Ninety-three *Siren* chosen at random from the 138 collected were examined in the museum laboratory, Southern Illinois Normal University. These specimens were killed in warm water, measured, weighed, and dissected to study the gonads. The stomachs of the first twenty examined were empty, and stomach examination was not continued. The number of costal grooves in this series varies between 32 and 34.

The ninety-three specimens were almost equally divided as to sex: forty-seven males and forty-six females. Of the forty-six females, twenty-four were sexually mature and contained large egg masses, weighing from 2.0 grams to 6.3 grams. The eggs were 1.6 to 2.00 mm. in diameter. Three of these mature females were selected and one gram of eggs taken from each. Each gram was counted carefully and the mean number used in computing the number of eggs in each female. According to the resulting calculation, the ovaries contained from 224 to 706 eggs. The number of eggs had little relation to the length or weight of the specimen.

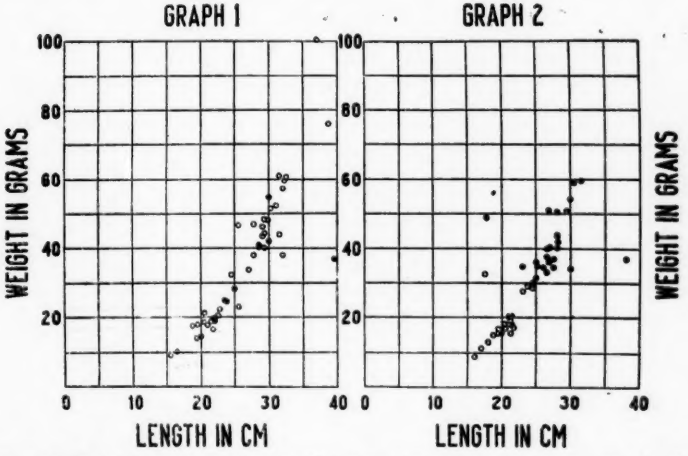

Fig. 1. Graph 1 indicates the length and weight of the male *Siren;* graph 2 the length and weight of the females. The black dots indicate the sexually mature females.

Graph 1 indicates the length and weight of the 47 males. No attempt was made to separate the mature from the immature. Graph 2 indicates the length and weight of the forty-six females; the solid dots indicate mature females. Both graphs indicate two age groups. We may conclude that specimens 15 cm. to 22 cm. in length have had one growing season and those between 23 and 32 cm. have had two growing seasons. If this is correct, females attain sexual maturity during the second growing season and reproduce during the next breeding period. The lengths of the mature females fall just within the limits for *Siren intermedia* as suggested by Noble and Marshall (1932, Amer. Mus. Novitates, 532: 14).

It is probable that this was a hibernating aggregation. The culvert offered excellent protection and ready access to either pond. It is possible that the salamanders were attracted from the ice covered ponds by the open water in the culvert. The time of year and the presence of the immature male and female *Siren* seem to eliminate the possibility that it was a breeding aggregation.—Fred R. Cagle and Philip E. Smith, *Southern Illinois Normal University, Carbondale, Illinois.*

YIELD AND TOXICITY OF VENOM FROM SNAKES EXTRACTED OVER A PERIOD OF TWO YEARS.—It has been reported by Klauber (1928, Bull. Antiven. Inst. Amer., 2: 11–18, figs. 1–9) and Freeman and Kellaway (1934, Med. Journ. Australia, 2: 373–377) that snakes in captivity from which the venom is repeatedly extracted gradually yield smaller quantities of venom, and that the venom also decreases in potency. Our observations on a group of water moccasins (*Agkistrodon piscivorus*) from which venom was extracted sixteen times over a period of two years indicate that this does not necessarily occur.

Fifteen of the snakes concerned were received from Mr. Ira D. George, of Baton Rouge, Louisiana, on October 21, 1935. Three snakes received in earlier shipments and three received later (September 8, 1936) are also included in the observations. These moccasins took well to captivity and ate regularly. The snakes were "milked" at irregular intervals. The longest time between extractions was six months, and the shortest time three weeks. The first five extractions were done by Mr. Joseph Hocking; the rest by one of the authors (N. O'C. W.). After the venom was taken from the snakes it was measured, centrifuged to remove epithelial scales, and then dried either by gentle heat or in a desiccator under vacuum. The toxicity was determined by injecting intravenously into pigeons a solution of the dried venom to determine the minimum lethal dose (MLD).

The following table gives complete data on the extractions over a two-year period. The low yields in extractions six to ten may easily be explained. These were the first extractions attempted by one of us (N. O'C. W.), who undoubtedly failed to obtain all the venom. If for some reason the first few extractions from this group of snakes had been below the average yields for the species, the indicated slight increase might be considered merely a return to the normal. We have included at the bottom of the table total and average figures for all our extractions from water moccasins for the past five years. A comparison will show that the extractions from this one group have with very few exceptions been equal to or better than the average for the species.

Extraction	Date	No. of snakes	Total cc.	Total gms.	cc. per snake	gms. per snake	% solids	MLD in mgm.	MLD per snake
1	5-25-36	13	6.5	2.08	0.500	0.16	32.0	0.08	2000
2	6-22-36	15	7.3	2.148	0.486	0.143	29.5	0.11	1300
3	7-7-36	12	6.2	1.704	0.517	0.142	27.0	0.09	1577
4	7-28-36	13	8.5	2.427	0.653	0.186	28.0	0.08	2325
5	8-26-36	15	9.0	2.551	0.600	0.170	28.0	0.06	2833
6	9-16-36	18	6.5	1.683	0.361	0.093	26.0	0.11	845
7	10-9-36	15	5.6	1.477	0.373	0.098	26.0	0.16	612
8	11-13-36	15	9.0	2.290	0.600	0.172	25.5	0.10	1720
9	12-3-36	15	5.0	1.232	0.333	0.082	24.5	0.10	820
10	12-29-36	13	4.5	1.045	0.345	0.080	23.0	0.08	1000
11	6-3-37	12	8.5	2.842	0.708	0.237	35.0	0.11	2155
12	8-3-37	11	7.0	2.111	0.636	0.191	30.0	0.09	2122
13	12-15-37	10	7.0	2.180	0.700	0.218	31.0	0.09	2311
14	1-12-38	10	5.5	1.265	0.550	0.126	23.0	0.05	2520
15	2-23-38	9	7.0	1.775	0.777	0.197	25.3	0.10	1970
16	4-14-38	9	6.5	1.802	0.722	0.200	28.0	0.08	2500
	5 year period	315	174.5	49.98	0.55	0.158	28.0	0.09	1755

From these observations it is clearly indicated that neither the yield nor the toxicity of venom produced necessarily decreases when a snake is kept in captivity and its venom repeatedly extracted.

SUMMARY

Twenty-one water moccasins were kept in captivity and their venom repeatedly extracted for a period of two years. No decrease was noticed in the toxicity of the venom or in the amount obtained at each extraction.—NIGEL O'CONNOR WOLFF and THOMAS S. GITHENS, *Mulford Biological Laboratories, Sharp & Dohme, Glenolden, Pennsylvania.*

NORTHERN RECORDS OF THE WOOD-FROG.—The northern boundary of the range of the wood-frog, *Rana sylvatica,* is outlined from west to east by specimens in the National Museum of Canada collection from the following localities: Carmacks, Yukon; Resolution, Great Slave Lake, Northwest Territories; Black Bay, Lake Athabaska, Saskatchewan; Herchmer, Manitoba (100 miles south of Churchill); Moose Factory, Charlton Island and Cape Hope Islands (near East Main), James Bay; Tadoussac, Quebec; Natashkwan, Quebec; Gaspé Basin, Quebec; Meramichi, New Brunswick; and Cape North, Cape Breton Island, Nova Scotia.

Starting in Yukon and ending in Nova Scotia, the following table gives the average figure for measurements in mm. of the body length, length of leg to heel, and length of foot of the specimens available:

Locality	No. Spec.	Body	Leg	Foot
Carmacks, Yukon	3	38	33	29
Telegraph Creek and Hazelton, British Columbia	6	36	30	28
Aldersyde and Whitemud River Valley, Alberta	3	42	39	32
Waskesiu Lake, Saskatchewan	2	35	32	29
The Pas, Moose Lake and Herchmer, Manitoba	7	39	36	31
Ninette, Treesbank and Winnipeg, Manitoba	6	33	29	26
Moose Factory, Charlton Island and Cape Hope Islands, James Bay	10	43	39	33
Kapuskasing, Ontario	6	44	41	34
Lac Seul, Ontario	2	38	34	30
Silver Inlet, Thunder Bay, Lake Superior, Ontario	8	41	41	35
Sault Ste Marie, Ontario	1	38	38	30
Ottawa, Ontario	21	34	35	28
Tadoussac, Quebec	1	45	45	39
Natashkwan, Quebec	1	38	37	30
Gaspé Basin, Quebec	1	45	47	38
Scotch Lake, New Brunswick	6	48	48	39
Cape North, Cheticamp, Truro and Halifax, Nova Scotia	6	52	53	42

Wood-frogs are variable in color and markings. For example, some individuals from western Canada, eastern Canada and Georgetown, Maryland, have spotted breasts, while others from the same localities have no breast markings. The upper surface is also variable, as mentioned by Wright and Wright (1934) and Trapido and Clausen (1938). It would appear that the feature distinguishing *cantabrigensis* from *sylvatica* is length of hind leg in comparison to body length. The table shows that specimens (*Rana sylvatica cantabrigensis*) from Yukon to James Bay and Natashkwan, Quebec (north of Anticosti Island), have the hind leg shorter than the body, and specimens (*Rana sylvatica sylvatica*) with the hind leg equal to or longer than the body occur in Nova Scotia, New Brunswick, Gaspé Peninsula, southern Quebec, and southern Ontario westward around Lake Superior. Trapido and Clausen (1938) refer specimens from Gaspé Peninsula, north shore of the St. Lawrence and eastern Quebec to *R. s. cantabrigensis.*

Schmidt and Necker (1935) and Schmidt (1938) assign the name *latiremis* to the northern frogs, thus indicating a southern distribution for *cantabrigensis* and *sylvatica.* If these three groupings are accepted it will be impossible to name certain individuals unless geographic boundaries are drawn to delineate ranges. If only *R. s. sylvatica* and *R. s. cantabrigensis* are recognized, identification by proportional measurements will be quite obvious.

References

Trapido, Harold and Clausen, R. T.
1938 Amphibians and reptiles of eastern Quebec. Copeia: 117–125.

Schmidt, K. P.
1938 A geographic variation gradient in frogs. *Zool. Ser. Field Mus. Nat. Hist.,* 20: 377–382.

Schmidt, K. P. and Necker, W. L.
1935 Amphibians and reptiles of the Chicago Region. *Bull. Chicago Acad. Sci.,* 5: 57–77.

Wright, A. A. and Wright, A. H.
1934 Handbook of frogs and toads. Comstock Publishing Co., Ithaca, N.Y.: 231 pp.

Clyde L. Patch, *National Museum of Canada, Ottawa, Ontario.*

Ichthyological Notes

A NEW GENUS OF CLARIID CATFISHES.—The union of the dorsal and anal fins with the caudal, forming a continuous fin, is a feature possessed by a single known clariid species and seems to merit generic distinction.

In 1844 McClelland (Description of a Collection of Fishes made at Chusan and Ningpo in China. Calcutta Jour. Nat. Hist., 4: 403, pl. xxii, fig. 3) proposed the name *Cossyphus ater* for a new genus and new species of catfish from Chusan. He noted that "in the specimen from which the genus is described the caudal was removed from the end of the tail and its place left vacant by an open fissure." His illustration clearly indicates a multilated specimen. In the next volume of the same journal (1845: 225) McClelland announced the discovery that the name *Cossyphus* had already been given to another fish genus by Valenciennes, so he substituted *Phagorus*, "the Greek name of an unknown kind of fish."

More than twenty years previously Hamilton (An Account of the Fishes found in the River Ganges and Its Branches, 1822) had described as a new species a fish "with the back fin united to that of the tail," giving it the specific name *jagur* and placing it in the genus *Macropteronotus* of Lacépède (1803), which is a synonym of *Clarias* of Scopoli (1777).

Günther (Catalogue, V, 1864) made McClelland's *Phagorus ater* a synonym of *Clarias jagur*, placing it with *C. nieuhofi* in a section characterized by having the caudal fin united with the dorsal and anal, although it will be noted that Hamilton's species was not so described.

Day (Fishes of India, 1878), placing *Phagorus* in the synonymy of *Clarias*, made a special division for *C. jagur* under the incorrect heading "vertical fins confluent with the caudal"; but in his *Fauna of British India—Fishes* (1889) Day stated that *jagur* "appears to be a monstrosity of *C. magur*, in which the last few vertebrae have been accidentally lost or removed, and the new caudal fin has become continuous with the dorsal fin superiorly and the anal inferiorly," again drawing on his imagination, because Hamilton's description made no reference to the union of the caudal and anal fins.

In a paper on *Siluroid Fishes of India, Burma, and Ceylon* (Records of the Indian Museum 38, 1936), Hora stated: "I am definitely of the opinion that *C. jagur* is only an abnormality of *C. magur* (= *C. batrachus*)."

The important points in this case are that the name *jagur* like the name *ater* was given to a monstrosity, and that McClelland's *Phagorus ater*, having been based on a mutilated specimen of *Clarias batrachus*, is a synonym thereof as to both generic and specific names.

A different view was once expressed by Fowler (Some Fishes of Borneo, 1905) who said: "*Phagorus* McClelland is a valid genus, differing in the confluent rayed dorsal, caudal, and anal. *Phagorus nieuhofi* (Valenciennes) examined."

It thus appears that clariid fishes with dorsal, caudal, and anal normally united into a single fin are without a valid generic name, and ***Prophagorus*** is now proposed as a new genus, with *P. nieuhofi* (Cuvier and Valenciennes) as the type.—HUGH M. SMITH, *United States National Museum, Washington, D.C.*

A STING RAY (*DASYATIS SAY*) NEW TO NEW ENGLAND.—The sting ray *Dasyatis say* (LeSueur), described from New Jersey in 1817, is common in Florida, North Carolina, and Chesapeake Bay, becoming rare northward. Garman, in *The Plagiostomia* (1913), gave New York as the limit of its northern range, but Nichols and Breder did not assign it a place in *The Marine Fishes of New York and Southern New England* (1927). Kendall, in *Fauna of New England, List of the Pisces* (1908), did not mention the species, and there appear to be no New England records.

We therefore believe it of interest to note the capture in a pound net in Buzzards Bay, Massachusetts, near Woods Hole, on July 14, 1939, of a female example of this species. The fish is 65 cm. in total length; the disk is 30 cm. long and 32 cm. wide, and the tail is 38 cm. long. The cutaneous flaps on the tail are blue-black, the one on the dorsal surface 7.5 cm. long and 4 mm. deep, the one on the ventral surface 11 cm. long and 7 mm. deep. The caudal spine is 3.5 cm. long. The disk, of a uniform yellowish-brown above and white below, is smooth except for a row of seven or eight small spines in the middle of the back.—HUGH M. SMITH and ROBERT A. GOFFIN, *Woods Hole, Massachusetts.*

CROSS BETWEEN *ESOX NIGER* AND *E. LUCIUS*.—In conducting field studies on the eastern chain pickerel, *Esox niger*, I have had the opportunity of artificially fertilizing the eggs of a pickerel with the milt of a pike, *Esox lucius*. This cross was made in April, 1937, and two of the progeny are now in their second winter. An attempt will be made to hold them for another year. To date, these hybrids have exhibited the intermediate characteristics noted by G. C. Embody (1918, Artificial Hybrids Between Pike and Pickerel, Journal of Heredity, 9 (6): 253-256). The largest specimen (40.7 cm. total length, Sept. 1938), however, shows the typical spotted color pattern of the adult pike. More complete information will be available upon the termination of the experiment.—A. HEATON UNDERHILL, *Laboratory of Fisheries and Limnology, Cornell University, Ithaca, New York.*

THE EGG CASE OF THE TEXAS SKATE.—Empty skate egg cases are common on the beach at Englewood, on the west coast of Florida. However, I had no means of identifying the species represented until March 2 when Captain William Ainger brought me an egg case containing a single embryo, 46 mm. across the disk, and obviously referable to *Raja texana* Chandler. The egg case was taken from a pompano net in shallow water. Anchorage had apparently been secured by means of a tangle of threads attached at each lateral margin near the end of the shell from which the embryo emerges, a method of attachment similar to that described for *Raja rhina* of the Pacific coast (DeLacy, Allan C., & Chapman, Wilbert M., COPEIA (2), 1935: 65). The egg case collected by Captain Ainger was said to be attached by these threads to a mass of green plants along with some calcareous material, possibly coral. It was 63 mm. long exclusive of horns, and 38 mm. wide. The dry egg cases such as those picked up on the beach are usually much smaller, probably owing to drying. It may be pointed out that considerable change in the size of egg cases is effected by preservatives. There is great shrinkage in alcohol and at least temporary swelling in formalin-sea-water.

In the original description of *R. texana* (Chandler, Asa, Proc. U. S. N. M., 59, 1921: 657-658) it is suggested that the species occupies a position intermediate between *R. eglanteria* of the Atlantic coast and *R. ackleyi* from Yucatan. I do not find a description of the egg case of *R. ackleyi*, but the egg case of *R. eglanteria* has been described (Breder, C. M. Jr., & Nichols, J. T., COPEIA (3), 1937: 181-184). As would be expected, the egg case of *R. texana* is similar to that of *R. eglanteria* but has one regularly present feature which distinguishes it from other skate egg cases of the east coast of the United States in the presence of lateral horns or tendrils near the permanently closed end of the shell. These horns are evidently variable in position and size, but have been present on all of the dozen or more shells that I have examined carefully. They are much smaller than the four principal horns and not very conspicuous in beach worn specimens. I have one dry case in which one of the accessory horns is folded over and fused to the wall of the shell, and I interpret this to mean that these horns are formed before the case is extruded from the oviduct.—STEWART SPRINGER, *Bass Biological Laboratory, Englewood, Florida.*

Reviews and Comments

DEEP-SEA FISHES OF THE BERMUDA OCEANOGRAPHIC EXPEDITIONS. FAMILY MELANOSTOMIATIDAE. By William Beebe and Jocelyn Crane. Zoologica, 24 (pt. 2), 1939: 65–238, 77 figs.—This paper appears to be a carefully digested piece of systematic work of the most useful type. It deals primarily with the Melanostomiatidae of Bermuda and the descriptions and figures of these fishes are adequate and more complete than is usual. The reviewer feels, however, that more extensive lists of proportions would not be amiss.

In addition to the systematic treatment of species from a restricted area, the work deals with broader aspects, and generalizations have been strengthened by examination of considerable material from other regions. The key to all of the known genera is excellent. The authors have recognized the primary function of the key as a tool for the determination of fishes and have used characters that may be examined without injury to the specimen. Osteological data dealing primarily with the jaws, branchial apparatus, and pectoral arches markedly advance our knowledge. Considerable information is presented on luminous organs and barbles, that dealing with developmental modifications and sexual dimorphism being most important. Also of extreme value is the inclusion of many data and figures of larval types. The syonymizing of several species on the basis of these investigations of immature forms clarifies the melanostomiatid picture considerably.

One interesting section discusses the phylogeny of the group and includes an evaluation of primitive, specialized, and adventitious characters. The authors' ideas are diagramed in a phylogenetic tree which includes character areas showing how the scheme of evolution was developed. By labeling the figure a "suggested phylogeny" they indicate that they realize that drastic revision may be necessary in the future, but the graphic presentation is both illuminating and well argued.

In this excellent piece of solid work, the inclusion of a description and figure of *Bathysphaera intacta* Beebe seems incongruous. It may be well to describe as accurately as possible the appearance of a fish seen through a bathysphere window and to guess at its systematic position. To assign a formal scientific name to it seems to me to be a very questionable procedure, and to drag that name into the discussion of a family to which it does not belong seems most dubious. The authors exclude *Bathysphaera* from the systematic section because they do not consider it to be a melanostomiatid. Why it should be included anywhere in this work is a mystery.—Rolf L. Bolin, *Hopkins Marine Station, Pacific Grove, California.*

BETWEEN PACIFIC TIDES. By Edward F. Ricketts and Jack Calvin. Stanford University Press, 1939: 306 pp., 112 figs. $6.00.—It is a hard problem to write about the great variety of animals found at the seashore so that a person without special training can easily identify what he finds. Yet that is what the authors of this book have undertaken to do, and they have done it remarkably well. Their method is most ingenious. They have divided the coastal region into divisions: Rocky Shores, Open Coast, Bay and Estuary, and Wharf Piling. Each of these they have further divided into habitat zones. For example, "Rocky Shores," is subdivided into: Uppermost Horizon, High-Tide Horizon, Mid-Tide Horizon and Low-Tide Horizon. It is a book to use in the field for studying entire communities as one sees them, rather than for identifying individual animals in the laboratory. To use the book, the reader must first determine the zone he is studying, which is not difficult, for the authors make themselves quite clear. Then he reads what is described under that zone. The book is illustrated with excellent photographs so that many species can be easily identified from them. Indeed, the text depends very heavily on the pictures, being sparing of descriptions. On the other hand, it is rich in life history lore, which more than makes up its lack of descriptive material. Furthermore, for those who wish more information than this book gives, there is a splendid annotated bibliography, with subject matter grouped by classes and orders.—L. A. Walford, *Jordan Hall, Stanford University, California.*

CHARACTER IN FISH. By Clifford Bower-Shore. The Epworth Press, London, 1938: 1–63, several plates. 1/6 (about 30c).—Fish, according to commonly accepted opinion, are merely biological automatons—creatures without feelings, emotions, or intelligence. The author of this book endeavors to show, by his personal experience at "water watching," that they are worthy of greater respect than this. He discusses ichthyological subjects of a more general nature, simplifying the biological processes to a remarkable degree. A charming little book for a collector.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

THE MIGRATION AND CONSERVATION OF SALMON. Edited by Forest Ray Moulton. Published for the American Association for the Advancement of Science by the Science Press, 1939: 106 pp., several figs. $2.00.—On June 29 and 30, 1938, a number of distinguished investigators met at Ottawa for a symposium on the migration and conservation of salmons, a subject the participants had been studying for their several governmental conservation agencies for several years. The formal papers presented have been published in the present volume, along with an edited report of the discussion following this symposium. Papers are presented by W. J. M. Menzies; David L. Belding; A. G. Huntsman; Willis H. Rich; W. A. Clemens, R. E. Foerster, and A. L. Pritchard; Henry B. Ward (whose paper, though given in this collection, was not actually delivered at the conference), and Edwin B. Powers.

Three of the five species of Pacific salmon are considered, as well as the Atlantic salmon. The bulk of the material in the papers describes the course of salmon migrations as deduced from experimental studies, and the mechanism controlling these migrations. Methods of conserving the salmon fisheries in the light of research results are barely touched upon, except in one of the papers.

To some of those at the symposium, the principal problem of the fisheries seems to be how to explain physiologically the movements of salmon. They ask: Is it environmental control, or is it blind instinct that directs the migrations? Over thirty percent of the book is devoted to this question. To this reviewer, this seems an example of the kind of blind alley that fishery research can get itself into when the ultimate aim becomes lost in a maze of academic questions. The important questions in salmon investigations which seem particularly pressing are these: How abundant are the populations? How large are the drains upon them? What are the facts of the life history that are needed to manage the fishery? What measures are needed to conserve the populations? In the latter connection, Dr. Huntsman's remark on page 43 is interesting: "It is hardly wise to conclude that conservation is necessary until there are facts to prove that the stock is endangered." This is like putting off the installation of fire extinguishers until the building starts burning.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

PALAEOZOIC FISHES. By J. A. Moy-Thomas. X+149 pp., 32 figs. Chemical Publishing Co., New York. 1939. $2.00.—The last two decades have witnessed what amounts to an epoch in the study of the early vertebrates. The ostracoderms have been placed once and for all as agnathous craniates related to the lampreys. The apparently anomalous lungfishes have been connected up with the crossopterygians, and the latter group has been definitely indicated as the starting point of the tetrapods. Happiest of all, the sharks (so solemnly pointed out to generations of zoology students as ideal primitive vertebrates) are now known to be neither as old nor as primitive as some bony fishes. Some of this newly discovered fact has filtered into the text-books, but not very much, and the present little book is the first serious attempt to place the really important modern knowledge of palaeozoic fishes before the general student. The author is a competent and well-known student of his subject, the text presents a large amount of pertinent information in very compact form, and the illustrations are adequate if not very elaborate. A modern classification of primitive fishes is presented; the reviewer's chief criticism concerns its terminology. He would rather call the Agnatha and Gnathostomata superclasses, preserving the term class for such divisions as the Aphetohyoidea, Elasmobranchii, Pisces (=Osteichthyes), and Amphibia.[1]—GEORGE S. MYERS, *Stanford University, California.*

[1] With the understanding that the classical "Amphibia" may possibly be polyphyletic and open to further division.

BIO-ECOLOGY. By F. E. Clements and V. E. Shelford. John Wiley & Sons, New York, 1939: vi+394. 85 figs. $4.50.—This book is a fine example of an important and already difficult subject discussed in an abstruse, involved, pompous, and thoroughly tiresome manner. Simple things are made complex, and complex things are made well-nigh incomprehensible. The cause of this condition seems to be that the authors have covered such a vast array of subject matter that they have not been able to digest much of it. It is no wonder, then, that they have made it seem indigestible. Nor is the mounting use of coined words helpful in elucidating the text. One is led almost to believe that ecology, as it is understood in the Clements-Shelford biome, is the occupation of thinking up new names for old things.

Nevertheless, the book is exceedingly useful as a guide to literature on animal populations, their occurrence, abundance, and inter-relations and contains much material on fishes. A bibliography of some 800 titles which are referred to constantly in the text, an excellent index, and a goodly number of fine and pertinent illustrations are particularly important features.—L. A. Walford and G. S. Myers, *Stanford University, California.*

REPTILES AND AMPHIBIANS AN ILLUSTRATED NATURAL HISTORY. Prepared by workers of the Federal Writers' Project of the Works Progress Administration in the City of New York (Ralph De Sola, editor). Albert Whitman & Co., Chicago, 1939: I–XII, 13–253, numerous illus. $2.25.—This volume affords a readily available and superficially attractive volume for the amateur. It has little value to the specialist. Its treatment of groups is extremely uneven, being governed largely by the availability of illustrations. The extraordinary lizard family Teiidae, for example, is dismissed with the mention of two forms. Its newly published (or at least unfamiliar) illustrations are counter-balanced by the many all-too-familiar photographs of posed alcoholic or otherwise dead specimens. While many of the half-tones are excellent, some have been crudely retouched. A few are mislabeled, such as the scheltopusik (p. 71), and the green tree frog (p. 235). The reviewer is positively gratified to see that the execrable fad of bleeding half-tone illustrations has led, as could have been predicted, to the cutting off of the noses of various forms.—Karl P. Schmidt, *Field Museum of Natural History, Chicago, Illinois.*

PLANT AND ANIMAL COMMUNITIES COMPRISING THE PROCEEDINGS OF THE CONFERENCE ON PLANT AND ANIMAL COMMUNITIES, HELD AT THE BIOLOGICAL LABORATORY, COLD SPRING HARBOR, LONG ISLAND, NEW YORK, FROM AUGUST 29 TO SEPTEMBER 2, 1938. Edited by Theodor Just. Amer. Mid. Nat., 21, 1939: 1–255, 15 figs. [Bound reprint $2.00].—Herpetologists and ichthyologists interested in the ecological concept of the biotic community will wish to refer to this volume, which offers the results of an important conference of plant and animal ecologists. Four of the essays are strictly botanical, five are essentially zoological, and one treats plants and animals together under the concept of the "biome." The essays on the various modifications of the concept of the plant association are important to the relatively simple studies in geographical ecology of the terrestrial vertebrates necessarily pursued by herpetologists. A wealth of terminology has grown up which is bewildering to the reader with no previous introduction to this development in plant ecology. The reviewer found Conard's "Plant associations on land" and Gleason's "The individualistic concept of plant association" most intelligible. Eggleton's "Fresh-water communities" and Macginitié's "Littoral marine communities" represent these two major habitats in the discussion of the animal community. Emerson's treatment of the complex insect societies as "superorganisms" emphasizes especially the integrating factors in this most remarkable type of community. Tinbergen (of the University of Leiden) gives a suggestive summary of our knowledge of integrating mechanisms in the social organization among vertebrates, with illustrations drawn especially from fishes and birds. Park's essay on analytical population studies emphasizes the fundamental importance of this phase of ecology, which can be transplanted to the laboratory in so far as it deals with creatures of small size. Herpetologists are reminded of the extreme paucity of population data of even the simplest observational kind for amphibians and reptiles.—Karl P. Schmidt, *Field Museum of Natural History, Chicago, Illinois.*

EDITORIAL NOTES AND NEWS

Summary of the 1939 Meeting

THE twenty-second annual meeting of the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS was held in Chicago, Illinois, from Tuesday evening, September 12, to Friday, September 15. The Local Committee and Governors assembled in the Medinah Club for dinner at 7 P.M., September 12. Following a brief, postprandial meeting of the Local Committee, the Board of Governors convened with VICE-PRESIDENT DYMOND presiding. The Chairman appointed C. L. TURNER, D. DWIGHT DAVIS, and C. M. BREDER, JR. as the Nominating Committee and M. B. TRAUTMAN, F. H. STOYE, and A. W. HENN as the Resolutions Committee for the convention. R. M. ANDERSON, C. M. BOGERT, ROLF L. BOLIN, W. H. CHUTE, H. K. GLOYD, CHAPMAN GRANT, A. S. HAZZARD, WALTER L. NECKER, MARGARET STOREY, LIONEL A. WALFORD, and CHARLES L. WALKER were elected to the Board of Governors to fill vacancies occasioned by deaths or resignations. The By-Laws were amended to increase the number of Honorary Foreign Members to fifteen, with the provision that the roll of such members was to be increased to this number immediately. Accordingly, the following were elected: L. D. BRONGERSMA, Leiden; GEORG DUNCKER, Hamburg; ADOLPHO LUTZ, Rio de Janeiro; ROBERT MERTENS, Frankfurt a.M.; J. R. NORMAN, London; H. W. PARKER, London; JACQUES PELLEGRIN, Paris; and P. J. SCHMIDT, Leningrad. The invitation of the Royal Ontario Museum of Zoology asking the Society to hold its 1940 meeting in Toronto was accepted; after considerable discussion it was decided that the meeting would be held in conjunction with that of the American Fisheries Society, our organization meeting on September 2 to 4 and the American Fisheries Society meeting on September 4 to 6. It was recommended that the Society attempt to meet in alternate years with this organization and the American Society of Mammalogists, and thus alternate spring and autumn dates as well. Since the one hundredth anniversary of the birth of Edward Drinker Cope will occur on July 28, 1940, Dr. Myers moved that a Cope Centenary Number be issued on or about this date, and that the number be prefaced with a good reproduction on coated paper of the fine portrait of Cope which hangs in Henry W. Fowler's office in the Philadelphia Academy; this motion was carried. After a discussion of the plans for indexing COPEIA the meeting adjourned at 10 P.M.

Sessions of September 13

FOLLOWING the registration of members, DR. CLIFFORD C. GREGG, Director of Field Museum of Natural History, opened the sessions with an address of welcome. The annual business meeting was called to order by VICE-PRESIDENT DYMOND at 10:30 A.M.

The SECRETARY reported that 65 new members were secured in the period of 14 months since the previous meeting; 6 members died, 14 resigned, 13 were dropped for non-payment of dues, and 2 were lost because of change in address. These changes resulted in a new gain of 30 members thereby increasing the total membership to 520. Twenty-one new subscribers were added during the period, and 2 were discontinued, which resulted in a net gain of 19 subscribers and increased the subscription list to 136. The total number of members and subscribers was 656 on August 31, 1939. A geographical analysis of the members and subscribers indicated that 109 copies of COPEIA go to 26 foreign countries, with Canada leading with 32 copies, followed by Great Britain with 13. The domestic copies total 547 distributed in 43 states and the District of Columbia; 90 in New York, 73 in California, and 41 in Michigan, the three leading states. The Society has neither members nor subscribers in Delaware, Idaho, Montana, and Nebraska. The rolls include 10 fully paid Life Members and 7 partial Life Members who have made one or more payments of $25.00 each.

The SECRETARY summarized the report of the TREASURER for the calendar year 1938 as follows: actual credit balance on January 1, 1938, $300.06; total receipts for the year 1938, including contributions toward printing, $2,156.65; expenditures, including $1,394.22

for the publishing of COPEIA, and $272.26 for the printing of reprints, totaled—$1,842.47. The actual credit balance on December 31, 1938, amounted to $618.26. On August 31, 1939, the amount on deposit in the Endowment Fund was $1,481.54.

The SECRETARY read the report of the ICHTHYOLOGICAL EDITOR in which he stated that additional short notes were needed to expand the "Ichthyological Notes" section of COPEIA. He asked for an expression of opinion upon unsigned "Committee" reviews. After considerable discussion a motion was passed providing that all reviews in COPEIA, whether prepared by one person or by a committee should be signed.

There were no formal standing committee reports, but Dr. Gloyd reported progress upon the inquiry into shipping regulations and the SECRETARY reported that the Committee on Conservation had been unable to find any method of curtailing the sale of hatchling turtles. The 65 new members proposed during the year were formally elected. The Nominating Committee presented its report and the SECRETARY was instructed to cast a ballot for the following officers: JOHN T. NICHOLS and LEONHARD STEJNEGER, *Honorary Presidents;* L. M. KLAUBER, *President;* JOHN R. DYMOND, PERCY VIOSCA, JR., and HOWARD K. GLOYD, *Vice-Presidents;* M. GRAHAM NETTING, *Secretary;* ARTHUR W. HENN, *Treasurer;* HELEN T. GAIGE, *Editor-in-Chief* of COPEIA; LIONEL A. WALFORD, *Ichthyological Editor;* KARL P. SCHMIDT, *Herpetological Editor.*

The SECRETARY gave a report on the business transacted at the Board of Governors. The business meeting adjourned at 11:45 A.M. after which the following papers were read and discussed:

1. Viviparity in Mexican Fishes—C. L. Turner.
2. A Bibliography of Herpetology and the Index to Copeia—Walter L. Necker.

During the afternoon session, which convened at 2 P.M., the following papers were presented:

3. Certain Implications of the Thermal Responses of Reptiles—Raymond B. Cowles.
4. Observations on the Hibernation of Desert Reptiles—Raymond B. Cowles.
5. Effects of Temperature on Snakes—F. X. Lueth.
6. Notes on the Ecology of Basiliscus basiliscus—Albert A. Barden, Jr.
7. Collecting, Captive Breeding, and the Young of the Queen Snake—Larry E. Tetzlaff.
8. Size at Sexual Maturity in the Common Suckers—W. A. Kennedy.
9. Amphibians of Florida—M. Graham Netting and Coleman J. Goin.
10. The Western Hog-nosed Snake, Heterodon nasicus, in Illinois—W. F. Stanley.
11. Food Habits of Turtles in Michigan—Karl F. Lagler.

The members assembled at the Zoology Department of Northwestern University at 8 P.M. for a very enjoyable open house during which the laboratories were inspected and refreshments were served.

Sessions of September 14

THE meeting opened at 9:20 A.M. in the Chicago Academy of Sciences for the reading of the following papers:

12. The Past History of the Visual Habits of Reptiles—Gordon L. Walls.
13. An Indexing Method for Herpetological Literature—Clifford H. Pope.
14. Frank Nelson Blanchard, Scholar and Teacher—Howard K. Gloyd.
15. What is a Line?—M. Graham Netting.
16. A New Frog from Louisiana and Mississippi—Coleman J. Goin and M. Graham Netting.
17. Notes on Four Dicephalic Snakes—J. Townsend Sacket.
18. Notes on Leptodeira annulata polysticta—T. P. Haines.
19. Habits and Habitat of the Massasauga in Northeastern Illinois—Bertrand A. Wright.

The ladies were entertained at luncheon in the South Shore Country Club by MRS. CHUTE. The afternoon sessions convened at 2:30 for the presentation of the following papers:

20. Occlusion of the Venom Duct in Crotalidae (demonstration)—Duval B. Jaros.
21. Collecting Necturus and Cryptobranchus (movies)—William G. Hassler.
22. Eumeces in Connecticut—Louis H. Babbitt.
23. Observations on Captive Snakes in Louisiana (color movies)—George P. Meade.

During a lull in the afternoon program the SECRETARY asked for an expression of opinion upon Dr. Osgood's proposal that the parentheses used with author's names be dropped. After heated discussion a vote was taken which indicated that a slight majority of those present was in favor of discontinuing the use of parentheses. A motion was passed instructing the Board of Governors to consider this matter at its next meeting.

At 8:00 P.M. the members assembled at the John G. Shedd Aquarium for a smoker and inspection of the aquarium. This gathering was one of the most successful in the history of the Society.

Sessions of September 15

THE meeting convened at 9 A.M. in the Shedd Aquarium for the reading of the following papers:

24. **The Coregonine Fishes of the Northwest Territories of Canada**—J. R. Dymond.
25. **Nesting of Smallmouth Bass in Ontario**—Kenneth H. Doan.
26. **Factors Affecting the Distribution of Fishes in Ohio**—Milton B. Trautman.
27. **Population Equilibria among the Fishes of Small Artificial Lakes**—George W. Bennett.
28. **Factors Affecting Hook-and-line Fishing in Rinaker Lake, 1932-1938**—David H. Thompson.
29. **New England Reptiles and Amphibians** (color movies)—Louis H. Babbitt.

Following a group photograph the morning session adjourned. The ladies were entertained at luncheon and a fashion show at Marshall Field and Company. The afternoon session opened at 2 P.M. in Shedd Aquarium for the presentation of the following papers:

30. **Some Observations on Gambusia in the Chicago Region**—Louis A. Krumholz.
31. **Age and Rate of Growth of the Bluegill**—C. L. Schloemer.
32. **The Otoliths of the Ostriophysi**—L. A. Adams.
33. **Regeneration in the Fins of Sunfishes**—Donald F. Hansen.
34. **Increased Number of Scales with Growth in the Arctic Char**—W. R. Martin.

The Annual Banquet was held at 8 P.M. in the Medinah Club. A notable feature of this occasion was the appearance of the first number of ICHTHERPS, a worthy addition to that group of pseudoscientific publications which follow the AUKLET tradition. Dr. Turner announced that the F. H. Stoye Prizes, of $10.00 each, for the best student papers had been awarded to Louis A. Krumholz for his ichthyological contribution and to Francis X. Lueth for his herpetological paper. The SECRETARY injected a note of business by requesting that the office of HISTORIAN be provided for, and that WALTER L. NECKER be elected to this office; this motion was approved unanimously.

CHAIRMAN TRAUTMAN of the Resolutions Committee submitted the following resolutions which were unanimously accepted:

I

Whereas, we the members of the American Society of Ichthyologists and Herpetologists, convened in our Annual Meeting at Chicago, Illinois, September 15, 1939, appreciate the many demands that are made on those responsible for planning and successfully conducting this meeting,

Therefore, we wish to extend our sincere thanks to the members of the Local Committee of Arrangements, who have so manifestly done their work well,

Further, we wish to acknowledge our gratitude to the institutions that have extended hospitality, namely, Field Museum of Natural History, the Chicago Academy of Science, and the John G. Shedd Aquarium.

II

Whereas, the continued, prosperous state of our Society, as shown in the Annual Reports of the Secretary and Treasurer, indicates the thoroughness with which these Officers have discharged their duties, and

Whereas, the sustained, high standard of our journal, COPEIA, reflects the unceasing efforts of our Editorial Board,

Therefore, be it resolved, that we, the members present at the 1939 Meeting, hereby express our hearty commendation and appreciation of the work of these Officers.

III

Whereas, one of our members, Mr. F. H. Stoye, has made possible the recognition of outstanding work among non-professional ichthyologists and herpetologists, by the presentation of prizes for the best papers in these fields given during the current Meetings,

Therefore, be it resolved, that the Society extend its sincere thanks to Mr. Stoye for his thoughtfulness and generosity.

IV

Whereas, all species of sturgeons of the Mississippi River system have been exploited by overfishing and the taking of immature individuals, and consequently have been greatly reduced in numbers, and

Whereas, these fishes continue to be taken and sold by commercial fishermen to the detriment of the fishermen's interests, and

Whereas, the discontinuance of these fisheries would work no particular hardship to the fishermen,

Therefore, the American Society of Ichthyologists and Herpetologists recommends the enactment of proper state and/or federal legislation for the adequate protection of these fishes in order to prevent their extermination.

DR. ANTON J. CARLSON, the scheduled banquet speaker, was unable to return to Chicago in time for the gathering, and his place was taken by WILLIAM G. HASSLER who exhibited excellent colored movies of amphibians and reptiles, and by WALTER H. CHUTE, who showed colored movies of a collecting trip to Hawaii which constituted a colorful and informative record of the field activities of the Shedd Aquarium staff.

The total registered attendance at the meeting was 111, of whom 50 were members and 61 guests; of the total attendance, 62 persons were from points other than Chicago and its suburbs. An unusual feature of the meeting was the large number of exhibits arranged by the host institutions. Field Museum exhibited the Walters' celluloid technique of reproducing amphibians and reptiles, and herpetological paintings and drawings by

A. A. Enzenbacher. The Chicago Academy of Science displayed a Salon of ichthyological and herpetological photographs; a collection of naturalist's book plates; an exhibit of technical illustrations, a grouping of local snake preparations made by amateur herpetologists; and a collection of portraits of herpetologists.—M. GRAHAM NETTING, *Secretary*.

News Notes

BIOLOGICAL ABSTRACTS is undertaking a more complete abstracting and segregation of the current research literature in bioclimatology and biometeorology. The section *Bioclimatology-Biometeorology* will appear within the section *Ecology*, and will be under the editorship of MR. ROBERT G. STONE of the Blue Hill Observatory, Harvard University.

H. E. WARFEL, formerly Assistant Professor of Zoology at Massachusetts State College, is now Biologist of the New Hampshire Fish and Game Department, replacing the late Earl E. Hoover. DR. CLINTON V. MAC COY, Assistant Biologist in the New Hampshire Fish and Game Department, has been appointed in Professor Warfel's place at Massachusetts State College.

MR. JOSEPH SLEVIN, Curator of the Department of Herpetology, California Academy of Sciences, recently returned from a five months expedition into Chiriqui Province, Panama. A large collection of amphibians and reptiles was secured, including some two hundred snakes representing about nineteen genera. Several new species records for Panama were obtained.

MR. ALVIN SEALE, Superintendent of the Steinhart Aquarium, San Francisco, left on October 20 for the Hawaiian Islands where he will spend four or five weeks collecting tropical fishes.

Recent Deaths

DR. E. VICTOR SMITH, Professor of Physiology at the University of Washington, died on September 28, at the age of 72. Among other lines of work, Dr. Smith carried on work in ichthyology and fisheries biology.

DR. RODOLPHO VON IHERING died at Saõ Paulo, Brazil, on September 15, 1939, following an attack of angina pectoris. At the time of his death, he was chief of the Serviço Nacional de Piscicultura, with headquarters in Rio de Janeiro.

Born in the south part of Brazil, of German parents, in 1883, von Ihering removed at an early age to the city of Saõ Paulo, where his father, Dr. Hermann von Ihering, organized and directed the Museu Paulista. Following completion of his secondary schooling in 1901, he went to Europe and graduated with the doctorate in natural history at Heidelberg. For several years he worked in the Saõ Paulo museum with his father, returning to Europe once, in 1908. From 1916 to 1926, Dr. von Ihering was engaged in commercial enterprises. In the latter year, he joined the staff of the Instituto Biologico, in Saõ Paulo, and later became head of the zoological division.

In 1933, Dr. von Ihering organized and directed the Commissão Technica de Piscicultura, a governmental agency designed to improve the fisheries in the semi-arid northeast part of Brazil. During the period 1933-1937, he called a number of foreign biologists to work with the regular Brazilian staff, and significant progress was made in some problems of fisheries management. Dr. von Ihering spent several months in the United States in 1936, visiting many of the leading laboratories and museums. In 1937, he organized the Serviço Nacional, and remained at its head until his death.

Dr. von Ihering's interests were extremely wide, and the scope of his acquaintance with both plants and animals was astonishing. His colleagues and many friends will always recall his zest for life, and tremendous enthusiasm in the search for knowledge. A large number of specialized and general works came from his pen. For a number of years he has spent much time in the compilation and revision of a dictionary of the Brazilian fauna, and fortunately this work was completed in recent months. In this country, von Ihering is known particularly for his part in the development of a method of controlling the spawning of fish by the use of pituitary extract.

Many phases of biology have been enriched by the contributions of the von Iherings, father and son, and their names will have important places in the history of biology in Brazil.—STILLMAN WRIGHT, *United States Bureau of Fisheries, Logan, Utah.*

INDEX TO SCIENTIFIC NAMES
1930, Nos. 1-4

New names and their principal references are printed in bold face type.

COPEIA IS THE JOURNAL OF THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS

Back numbers of COPEIA, all yet available, may be procured through the Secretary. Prices will be furnished on application.

Subscription, $3.00 per annum, 75c a copy.

Dues to Society, $3.00 per annum, including subscription to COPEIA.

Life Membership, $75.00, payable in one sum or three annual payments.

Dues and subscriptions are payable to the Society, through the Secretary.

Members should notify the Secretary immediately of any change in address.

Manuscripts, news items, and all correspondence regarding the Journal, should be addressed to one of the Editors.

Manuscripts should be submitted on good paper, as original typewritten copy, double-spaced, carefully corrected. Galley proof will be furnished authors.

Original contributions, not to be published elsewhere, are alone acceptable.

Reprints are furnished at approximate cost.

Figures, author's corrections, expensive tabular matter and unusually long articles may be charged in whole or in part to the author, at the discretion of the Editors.


ΙΧΘΥΣ
ΒΑΤΡΑΧΟΣ
ΕΡΠΕΤΟΝ

C 37